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Molecular Actions in Induced Magnetism.

In last week's issue of the REVIEW was given an abstract of a paper read before the British Association by Prof. Ewing, detailing some interesting experiments made with a number of small pivoted magnets arranged on a board and surrounded by a coil of wire, through which a current was passed. The movements of the little magnets simulate the movements of the molecules of iron when influenced by induced magnetism. The following is an abstract of another part of Prof. Ewing's paper which was not under our notice at the time of preparing the matter published last week.

The phenomena of permeability and retentiveness, and hysteresis generally, are, in the light of those experiments, explicable without supposing the molecules subject to frictional resistance or any other opposing force than their own mutual magnetic attractions and repulsions. Hysteresis is thus shown to be not an incident of frictional or quasi-frictional resistance, but is a magnetic opposition to change from one stable position of molecular equilibrium to another through an intermediate unstable position. In the model, the energy expended in overcoming this opposition sets the little magnets swinging; in an actual molecular motion, eddy currents are induced by this swinging motion. If the little magnets be provided with air vanes so as to damp their swings, the analogy of the model to a real magnetic mass will be complete and furnish a good illustration of what has been called magnetic viscosity. When the magnetizing current reaches a critical value, one of the outer magnets becomes unstable and swings slowly around; its next neighbor follows suit and the disturbance spreads through the group in a way eminently suggestive of the phenomena of time lag in magnetization. The model also explains the phenomena of a greater induction with a sudden application of a magnetizing force than with one gradually applied, as well as that of less residual magnetism with a sudden removal than with a gradual removal of the magnetizing force. The uncommon effects of mechanical vibration in augmenting magnetic susceptibility and reducing retentiveness, are explicable by considering that vibration will cause primitive changes in the distances between molecular centers. The effects of these upon magnetization were ingeniously copied by mounting the needle supports of the little magnets on a sheet of india-rubber which was stretched so as to vary the distances between the centers of the magnetic axes. When pulling stress was applied the rows of molecular magnets which lie more or less along the direction of stress had their stability reduced by the lengthening of the lines of centers; similarly, rows which lie more or less normal to the stress have their stability increased. The resulting effect on the general susceptibility of the material will depend on which of these conflicting influences preponderates.

From the action of this simple model, Prof. Ewing concluded:

"1. That in considering the magnetization of iron and other magnetic metals to be caused by the turning of permanent molecular magnets, we may look simply to the magnetic forces which the molecular magnets exert on one another as the cause of their directional stability. There is no need to suppose the existence of any quasi-elastic directing force or of any quasi-frictional resistance to rotation.

"2. That the intermolecular magnetic forces are sufficient to account for all the general characteristics of the process of magnetization, including the variations of susceptibility which occur as the magnetizing force is increased.

"3. That the intermolecular magnetic forces are equally competent to account for the known facts of retentiveness and coercive force and the characteristics of cyclic magnetic processes.

"4. That magnetic hysteresis and the dissipation of energy which hysteresis involves, are due to molecular instability resulting from intermolecular magnetic actions, and are not due to anything in the nature of frictional resistance to the rotation of the molecular magnets.

"5. That this theory is wide enough to admit explanation of the differences in magnetic quality which are shown by different substances or by the same substance in different states.

"6. That it accounts in a general way for the known effects of vibration, of temperature, and of stress upon magnetic quality.

"7. That, in particular, it accounts for the known fact that there is hysteresis in the relation of magnetism to stress.

"8. That it further explains why there is, in magnetic metals, hysteresis in physical quality generally with respect to stress, apart from the existence of magnetization.

"9. That, in consequence, any (not very small) cycle of stress occuring in a magnetic metal involves dissipation of energy."

Kind Words from an Esteemed Admirer of this Journal.

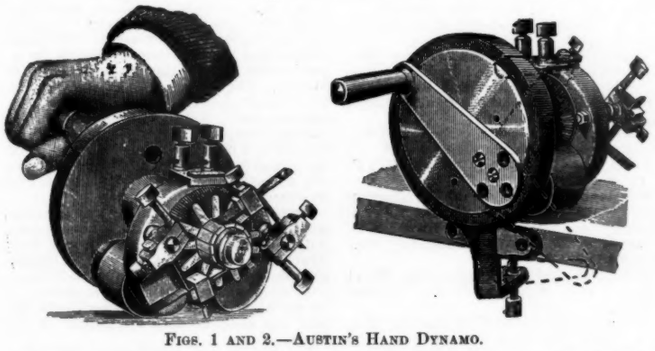
The Secretary of the ELECTRICAL REVIEW Publishing Company recently received from a Boston gentleman of discernment a letter of congratulation over the progress evidenced last week in the columns of this journal. We extract the following, which we think will be agreed with by every electrical reader:

"It has been a source of great pleasure, as well as pride, to the writer, to have noticed for several weeks past how the REVIEW has distanced all its competitors; and I sincerely congratulate you and your associates that richly deserved prosperity has crowned your efforts. It is gratifying to observe that sensible and appreciative business men among the electrical industries and kindred trades are awakening to the realization of the fact that the ELECTRICAL REVIEW is the leading and most influential electrical journal in the United States. Success to the REVIEW."

Austin's Hand-Power Dynamo.

Those who have to make experiments demanding electric current, and involving the use of half a dozen cells or so, will thoroughly appreciate the advantage of being able to get their small power without having to spend a couple of hours fitting up the cells and looking for binding screws, and two more in washing the cells out when the experiment is over or the cells run down, the latter circumstance being generally the first to occur. We give an engraving of a small hand-dynamo, brought out by Mr. H. Austin, of Armley, and are indebted to our esteemed contemporary, *Industries*, for it. It is wound to give a large enough output to work a large induction coil, or to light a small incandescent lamp, or, in fact, to do anything for which batteries are at present used in the lecture room or laboratory. The speed multiplication is carried out by friction gear, so as to run smoothly with very little loss of power. It can be fixed temporarily or permanently to any convenient bench, and three leverages or lengths of handle can be got by screwing it on in the different positions shown by full and dotted lines, as shown in Fig. 2.

We wonder some enterprising maker does not bring out a small dynamo-motor for transforming the power from, say, one large cell giving 2 volts and 50 amperes, to 100 volts and 1 ampere. It is not so troublesome to fit up one large cell, and by this means powers too large to be got by hand without fatigue would be easily obtained for laboratory work.



FIGS. 1 AND 2.—AUSTIN'S HAND DYNAMO.

The Latest Figures.

Whipple's Reports for October furnish the following information:

CENTRAL ELECTRIC LIGHT STATIONS.

Stations in United States	1,488
" Canada	104
" Cuba	1
" Mexico	9
Total Stations	1,602

GAS COMPANIES.

Companies in United States	968
" Canada	49
" Mexico	1
Total	1,018
Companies operating Electric Lights, U. S.	275
" " " " Canada	20
" " " " Mexico	1
Total	296

STREET RAILWAY COMPANIES.

Companies in United States	863
" Canada	22
Total	885
Electric Roads in Operation and under Contract in United States	243
Electric Roads in Operation and under Contract in Canada	5
Total	248
Cable Roads in the United States	44

THE STREET RAILWAY CONVENTION.

ELECTRIC POWER A LEADING TOPIC. —ADDRESS OF PRESIDENT LOWRY.

Dr. W. L. Allen's Interesting Address on "Electric Power Technically Considered."—Storage Batteries Fully Discussed. —General Notes.

The ninth annual meeting of The American Street Railway Association, was held at the Hotel Iroquois, Buffalo, N. Y., October 15–17, 1890. There was an attendance, all told, of nearly 400.

The president of the Association, Mr. Thomas Lowry, of Minneapolis, Minn., presided. Mr. Wm. J. Richardson, of Brooklyn, N. Y., the handsome secretary of the Association, was also present.

The following is a list of delegates of members of the Association, nearly all of whom were present:

Atlanta, Ga.—W. S. Larendon, superintendent Atlanta Street Railway Co.

Baltimore, Md.—Wm. A. House, Jr., general manager Baltimore Traction Co.

Birmingham, Conn.—H. Holton Wood, president Darby Horse Railway Co.

Boston, Mass.—Edmond Reardon, vice-president; F. H. Monks, general manager; Louis Pfingst, master mechanic, West End Street Railway Co. A. F. Breed, president; E. C. Foster, superintendent, Lynn & Boston Railroad Co.

Bridgeport, Conn.—B. F. Lasher, superintendent Bridgeport Horse Railway Co.

Brockton, Mass.—Wm. M. Cross, president; H. B. Rogers, general manager, Brockton Street Railway Co.

Brooklyn, N.Y.—Wm. Richardson, president; W. J. Richardson, secretary, Atlantic Avenue Railway Co. D. F. Lewis, president; E. W. Bliss, director, Brooklyn City Railway Co. D. F. Lewis, president; E. W. Bliss, director, New Williamsburgh & Flatbush Railway Co.

Buffalo, N. Y.—S. S. Spaulding, president; H. M. Watson, treasurer, Buffalo East Side Railway Co. H. M. Watson, president; S. S. Spaulding, secretary, Buffalo Street Railway Co.

Camden, N. J.—Wm. S. Scull, president; Morris W. Hall, secretary; G. G. Browning, treasurer, Camden Horse Railway Co.

Canton, Ohio.—F. A. Seiberling, treasurer; W. D. Chapman, engineer, Canton Street Railway Co.

Chicago, Ill.—H. H. Windsor, secretary; T. C. Pennington, treasurer, Chicago City Railway Co.

Cincinnati, Ohio.—H. M. Littell, president Cincinnati Inclined Plane Railway Co., and Henry Martin, president Mount Auburn Cable Railway Co. J. A. Collins, secretary; John Harris, superintendent, Cincinnati Street Railway Co. Jos. Thoms, director Mt. Adams Inclined Plane Railway Co.

Cleveland, O.—J. J. Stanley and Horace Andrews, of the Broadway and Newburg Railroad Co. President, Chas. W. Mason, electrical engineer, and H. A. Everett, secretary, East Cleveland Railroad Co.

Covington, Ky.—G. M. Abbott, treasurer; George Bullock, South Covington and Cincinnati Railway Co.

Davenport, Iowa.—Wm. L. Allen, president, Davenport Central Railway Co.

Detroit, Mich.—Jas. H. Vhay, secretary; N. W. Goodwin, secretary, Fort Wayne and Elmwood Railway Co.

Dover, N. H.—H. W. Burgett, vice-president Union Street Railway Co.

Easton, Pa.—H. A. Sage, president Easton, South Easton and West End Railway Co.

Fall River, Mass.—Robt. E. Goff, secretary Globe Street Railway Co.

Findlay, Ohio.—Chas. Smith, superintendent Findlay Street Railway Co.

Hamilton, Ont.—B. E. Carlton, president; T. B. Griffith, secretary and treasurer; J. B. Griffith, Hamilton Street Railway Co.

Harrisburg, Pa.—H. A. Kelker, president; A. Roberts, secretary, Harrisburg City Passenger Railway Co.

Hartford, Conn.—E. S. Goodrich, president Hartford and Weathersfield Railway Co.

Indianapolis, Ind.—J. C. Shaffer, president Citizens' Street Railway Co.

Kansas City, Mo.—R. J. McCarty, general manager Metropolitan Street Railway Co.

Lafayette, Ind.—G. E. C. Johnson, president; R. J. Hawver, superintendent, Lafayette Street Railway Co.

Lincoln, Neb.—E. L. Woolley, superintendent Lincoln Street Railway Co.

Little Rock, Ark.—H. B. Bradford, secretary; J. M. Gaylor, director, Little Rock & Citizens' Street Railway Co.

London, Can.—V. Cronyn, president; T. H. Smallman, director, London Street Railway Co.

Louisville, Ky.—H. H. Littell, general manager Louisville Railway Co.

Lowell, Mass.—E. M. Tucker, president; E. J. Noyes, superintendent, and Frank M. Howe, director, Lowell Horse Railroad Co.

Manchester, N. H.—C. Williams, president; N. H. Walker, superintendent, Manchester Street Railway Co.

Memphis, Tenn.—R. Semmes, of the Citizens' Street Railway Co.

Minneapolis, Minn.—Thomas Lowry, president Minneapolis Street Railway Co.

Nashua, N. H.—George H. Knowles, president, and Chas. Williams, director, Nashua Street Railway Co.

Newark, N. J.—Thomas C. Barr, president Newark Passenger Railway Co.

Newburyport, Mass.—C. Odell, president; J. K. Kerr, substitute; T. H. Johnson and R. R. Brown, directors, Newburyport & Amesbury Horse Railroad Co.

New York City, N. Y.—Wm. Richardson, director Dry Dock, East Broadway & Battery Railway Co. G. Green, President; J. M. Calhoun, superintendent, Forty-second Street & Grand Street Ferry Railway Co. W. H. Delaney, president; R. Avery, director, North & East River Railroad Co. T. F. McLean, secretary Twenty-third Street Railway Co. D. B. Hasbrouck, vice-president Houston, West street and Pavonia Ferry Railroad Co. C. Densmore Wyman, vice-president, and J. N. Valentine, secretary, Central Park, North and East River Railroad Co.

Niagara Falls, N. Y.—C. B. Gaskill, president; C. B. Hill, secretary; G. B. Johnson, superintendent; B. H. Johnson, A. Mevot and A. J. Porter, directors; Niagara Falls & Suspension Bridge Railway Co.

Omaha, Neb.—W. A. Smith, general manager Omaha Street Railway Co.

Orange, N. J.—F. M. Eppley, president Orange Crosstown & Bloomfield Street Railway Co.

Ottawa, Can.—T. C. Keefer, president Ottawa City Passenger Railway Co.

Peoria, Ill.—H. R. Woodward, vice-president and general manager of the Central Railway Co.

Philadelphia, Pa.—E. B. Murphy, president Lombard & South Street Passenger Railway Co.; E. B. Murphy, president People's Passenger Railway Co.

Pittsburgh, Pa.—J. G. Holmes, president; J. E. Rugg, superintendent, Citizens' Traction Co. D. F. Henry, president; W. M. Ramsey, electric superintendent, Federal Street & Pleasant Valley Passenger Railway Co.

Providence, R. I.—M. H. Bronsdon, superintendent Providence Cable Tramway Co.; A. T. Potter, general manager; H. V. A. Joslin, secretary, Union Railroad Co.

Reading, Pa.—B. F. Owen, president Reading City Passenger Railway Co.

Rochester, N. Y.—A. G. Yates, president; J. N. Beckley, vice-president; A. Luetchford, treasurer; M. A. Verner, general manager; S. McKee and Fred. Cook, directors, Rochester Railway Co.

Salt Lake City, Utah.—Walter P. Reed, superintendent Salt Lake City Railroad Co.

Sandusky, Ohio.—C. Rude, superintendent Sandusky Street Railway Co.

Savannah, Ga.—Henry Parsons, engineer, and George Parsons, director, City and Suburban Railway Co.

Sioux City, Iowa.—C. W. Hornick, president Riverside Park Railway Co. J. F. Peavey, president Sioux City Street Railway Co.

Springfield, Mass.—A. E. Smith, treasurer Springfield Street Railway Co.

St. Louis, Mo.—Chas. Green, president People's Railway Co. R. McCulloch, general manager St. Louis Railway Co.

St. Paul, Minn.—Thomas Lowrey, president St. Paul City Railway Co.

Taunton, Mass.—George C. Morse, superintendent Taunton Street Railway Co.

Terre Haute, Ind.—R. M. Rippetoe, president, and Leslie D. Thomas, secretary, Terre Haute Street Railway Co.

Toledo, Ohio.—A. E. Lang, president; D. E. Bailey, Toledo Consolidated Street Railway Co.

Topeka, Kan.—C. S. Gleed, president; E. H. Littlefield, superintendent, Topeka City Railway Co.

Toronto, Can.—J. Gunn, secretary; G. W. Kiely, managing director; G. F. Shipley, solicitor, Toronto Street Railway Co.

Trenton, N. J.—C. Y. Bamford, treasurer; A. L. Worthington, director, City Railway Co. L. Perrine, Jr., president; W. S. Gulick, assistant superintendent, Trenton Horse Railroad Co.

Troy, N. Y.—Chas. Cleminshaw and Chas. H. Smith, superintendent of the Troy and Lansingburg Railroad Co.

Washington, D. C.—Wm. Dunlap and C. C. Sailor, superintendent of the Washington and Georgetown Railroad Co.; George W. Pearson, president, and Robert Beal, director, of the Metropolitan Railroad Co., and J. Stephenson, president, and R. F. Baker, secretary and treasurer, of the Columbia Railroad Co.

West Haven, Conn.—I. A. Kelsey, president; S. A. Stevens, secretary, New Haven and West Avenue Horse Railway Co.

Wilmington, Del.—E. W. Heald, general manager Wilmington City Railway Co.

Worcester, Mass.—C. B. Pratt, president; H. S. Seeley, secretary, Worcester Consolidated Railway Co.

York, Pa.—W. H. Lanius, president; D. K. Trimmer, secretary; F. Guise, treasurer; D. K. Rupp, stockholder, York Street Railway Co.

Of the roads which were not members of the Association the following were represented by the gentlemen named:

Alton, Ill.—Alton Improvement Association, H. R. Kinney, secretary.

Asheville, N. C.—Asheville Street Railway Co., B. M. Jones, secretary and treasurer.

Boston, Mass.—Boston and Revere Electric Railway Co., W. G. Benedict, president; N. M. Jewett, director.

Decatur, Ill.—Citizens' Electric Street Railway Co., Wm. L. Ferguson, superintendent.

Erie, Pa.—Erie Passenger Railway Co., J. F. Pfetch, general manager.

Fort Scott, Kan.—Fort Scott Rapid Transit Railway Co., A. L. Hughes, treasurer.

Forth Worth, Tex.—North Side Railway Co., George B. Hendricks, secretary.

Joliet, Ill.—Joliet Street Railway Co., John Hulsizer, secretary.

Lawrence, Mass.—Merrimac Valley Railway Co., W. B. Ferguson, president; John Munningham, director.

Oswego, N. Y.—Oswego Street Railway Co., Francis J. Callanan, president.

Piqua, O.—Piqua Street Railway Co., F. C. Davies, secretary.

Plymouth, Mass.—Plymouth and Kingston Street Railway Co., C. E. Barnes, superintendent.

Pottsville, Pa.—People's Railway Co., Wm. D. Baber.

Richmond, Ind.—Richmond City Street Railway Co., Wm. H. Shaffer, general manager.

Salem, Ore.—Capital City Railway Co., P. S. Knight, president.

St. Joseph, Mo.—Wyatt Park Railway Co., W. J. Hobson, president.

Wheeling, W. Va.—Citizens' Railway Co., J. A. Miller, president; M. Loftus, superintendent; John M. Sweeney, director. Wheeling Railway Co., John M. Sweeney, president; M. Loftus, superintendent.

There was also a very large attendance of street railway supply dealers, inventors, newspaper men and others; nearly every firm of importance and all the technical papers having representatives present. The names of these gentlemen and their companies appear elsewhere in this report.

PRESIDENT LOWRY'S ADDRESS.

The president of the Association delivered the following address:

I am pleased to meet you in this beautiful city of Buffalo, assembled in the Ninth Annual Convention of the American Street Railway Association.

I congratulate you upon the progress made and past good work of the Association. When organized in 1882, in the city of Boston, street railroading was in its infancy, but such rapid advancement has since been made in city passenger traffic that the United States Government has deemed it of sufficient importance to incorporate in its census statistics, for 1890, a report on street railways in cities of over 50,000 inhabitants. In this report 56 cities are included, and out of a total of 3,150 miles of track in these cities, 2,351 miles are operated by horses; 260 miles by electricity; 255 miles by cable; 221 miles by steam, and the balance, about 60 miles, being the elevated roads in New York and Brooklyn. This report would seem to indicate that, in the larger cities, the faithful old horse is still the favorite propelling power for street cars.

The first special subject on which we are to receive a report from a committee appointed at the last Convention, is "A Perfect Street Railway Horse." From this we must assume that the Association has not yet discarded the idea that the horse is the most reliable power for street cars.

In the smaller cities electricity is generally being adopted, and I am informed that there are already in operation in cities and towns outside of those enumerated in the census report, about 1,600 miles of electric street railways. I am so thoroughly convinced that electricity is the coming power for street railways (except on heavy grades, where the cable is best suited), and that it will prove so effective, as a means of rapid transit for cities, that I believe this is the last Convention that will ever seriously consider horses for the operation of street railways.

Rapid transit in growing cities is becoming a necessity. While municipal corporations in the larger cities for many reasons are slow to grant new privileges to corporations, and in the case of electricity they are very closely scanned and criticised, it will soon become self-evident that a municipal body can grant no greater boon to its middle and laboring classes than to provide them with the means of rapid and cheap transportation to and from homes in the suburbs, where they can live under a clear sky and in a health-giving atmosphere. When the people of a city understand clearly the great benefits of rapid transit, by electricity or other improved motive power, over horses, they will demand that their city authorities grant such rights as will enable street railway companies to operate by the most improved methods.

Heretofore street railway securities have not been looked upon by the financial world with favor. However, since they have been so successfully operated by electricity, the financial men of the country are looking to its development and application to street railways as an additional reliable security for the investment of savings and trust funds. This should give encouragement to street railway companies to give their various cities the most improved and best possible service. They will not only please their patrons but the investment will prove very profitable. If street railway companies do this, no better security can be offered for the savings of the widow and orphan than a good street railway bond in a thriving city.

In order to bring this about, municipal corporations should grant liberal franchises for street railway improvement. The bond of the street railway company should be as good as the bond of the city in which it is located. The growth of the city is, to a large extent, dependent on street railway extensions, and the prosperity of the street railway company means the prosperity of the city in which it is located. It is one of the largest factors in the development of any city and as necessary as are its schools and its churches.

On the other hand the street railway company should be required to equip its road with the finest and most modern cars, construct the best and most substantial tracks, so as to inconvenience the public as little as possible in making repairs, and in short supply the road in every department with the best and most modern appliances of all kinds.

In view of the agitation of the labor question, it may not be out of place for me to say a word on that subject. In so doing it will only be the expression of an individual opinion, not intended to bind the Convention to the views expressed. When organizations are formed by laborers and others for the purpose of building up and dignifying its members as men and women, or to improve their moral, physical or financial condition, no one would foster or favor them more than he who now addresses you. Unfortunately, however, most of the present so-called labor organizations are the worst delusion and snare into which a laboring man was ever entrapped. The recent "strike" on the New York Central Road developed a state of cruelty, depravity and wrong that should make it the absolute duty of ever corporation, having public interests to subserve and charged with providing for the comfort, convenience, business necessities and, above all, the life and property of its patrons, to refuse to employ, or to retain in its employ, any one who does not renounce his connection with the "Knights of Labor" or any other labor organization, the rules of which permit employés of a corporation to be "ordered to strike." Men have a right to quit work with such notice as the contract with their employers requires, either singly or in a body, if the terms of their employment are not satisfactory; but they have not the right to interfere with those employed to supply their places. The first duty of a lawyer is to his client, of a doctor to his patient, a minister to his congregation, and a teacher to his pupil. The engineer, the conductor, the switchman, have even a greater responsibility, as the lives of the passengers are in their keeping, and in order to properly discharge it they must be loyal to their employers. They cannot be plotting and laying out rules for their employer and be faithful in the discharge of their duty. "The laborer is worthy of his hire"; but when he seeks to change the relation between himself and his employer, by asserting himself as master, he ceases to be the laborer that is "worthy of his hire." He also unfits himself for any kind of advancement. A man to be successful, and take advantage of promotion earned by efficiency, must be contented and perform his work cheerfully. A "labor agitator" cannot be contented or work in the interest of his employer. A few days ago United States Commissioner Rogers rendered a decision at Baltimore, in a case where four sailors were arrested for refusing to go aboard a schooner after they had signed articles to do so. The Knights of Labor interfered and undertook to defend the prisoners. I cannot express my views better on this question than to quote from the decision of Commissioner Rogers, who said:

"I perceive you are men of intelligence, and, no doubt, know and appreciate the advantages of union. Every man has a perfect right to unite with his fellow man to better his condition in life. There is one great mistake made, however, and that is the constant conflict of labor and capital. Now, I can't see why such a state of affairs should exist, because labor is in itself capital, and capital merely represents labor. A capitalist you will find is a man of strictly sober habits. He has to keep a clear head. And the man who to-day earns a dollar and to-morrow morning wakes up with 75 cents in his pocket is the man who may become a capitalist. No doubt your union is a good thing; the land we live in is a union. But now let me impress upon your minds that, while you have a perfect right to form a union, you have no right to interfere with the manner in which another man conducts his business. When a union attempts to interfere with or molest a free born American, or tries to prevent his earning a living, simply because he does not join that union, it then becomes a conspiracy, and amenable under the law and punishable by the court. The great trouble with the unions is, that they overstep their bounds, and endeavor to force people to do as they direct, and that is an act in direct violation of the laws which grant an American citizen his liberty. In these days of enlightenment and freedom, the press—the most powerful agent of the people—is ever ready to air the grievances of any one who is oppressed or molested. Nothing, from the great acts of a government to the death of a pauper, escapes the eagle eye of the press. Tyrants fear the press more than any other power which can be brought to bear against them; and the press of America, as it is to day, edited by men of the greatest ability and highest order of enlightenment, is the bulwark of the country. Now, in conclusion, let me say to you that the man who endeavors to persuade you to fight against capital, except in a legal manner, is no friend."

I thank you for your attention, and I hope your deliberations will be characterized by the good judgment and discretion you have always heretofore exhibited.

The treasurer's report was read, and showed the financial transactions during the year to be as follows:

Receipts	$7,165.91
Expenses	5,389.96
Balance on hand	$1,775.95

The following is an extract from the report of the Executive Committee:

"The subject 'Electric Motive Power Technically Considered,' was selected for the purpose of having the cobwebs, which were for the most part confessedly in our mind's eye, brushed away from this occult science, in order that it might be as plainly comprehensible to the ordinary street railway man as to the expert who manipulates the wires.

"The necessity for this knowledge is becoming greater as the days go by, for the transition of roads from horse to electric power is of almost daily occurrence, so rapid is the progress made by electricity as a motive power. In this connection we take occasion to say that the information which it is hoped will be freely given at this meeting, concerning the cost of operation by electricity, will, doubtless, still more rapidly hasten the emancipation of the horse from his bondage."

DR. ALLEN'S ADDRESS ON ELECTRIC POWER.

Then followed the Report of the Committee on Electric Motive Power Technically Considered, by Dr. W. L. Allen, of Davenport, Iowa:

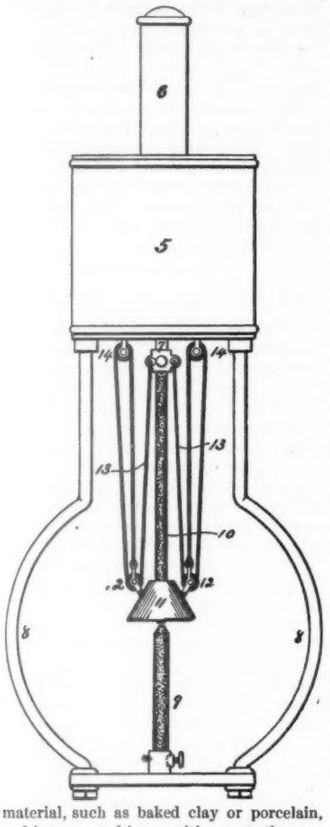
To go over the entire subject of electricity for street railways, and consider all the tech-

(Continued on page 106.)

SOME RECENT ELECTRICAL PATENTS.

LENGTHENING THE LIFE OF CARBONS.

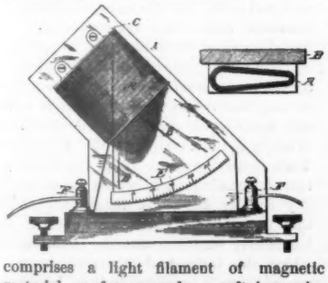
In the accompanying engraving is illustrated an invention of C. W. Hazeltine, of St. Louis, Mo., for increasing the lasting power of arc lamp carbons. As will be understood from an inspection of the engraving, a conical shield 11 surrounds the upper carbon, being supported in position by a system of pulleys and cords which permit the shield to feed downwardly as the carbons consume. The shield is made of refractory



material, such as baked clay or porcelain, and is supported in a position near the arc. In order to keep it constantly in this position, the ends of the cords 13 are secured to the carbon-holder 7, and the system of pulleys is so arranged that the amount of downward feed of the protective tip will be equal to one-third of the feed of the upper carbon; this is to compensate for the consumption of the lower carbon as well as for that of the upper carbon. The perforation in the shield 11 through which the upper carbon projects is sufficiently large to permit the latter to feed freely therethrough. It is stated that by the application of this simple device to an arc lamp the consumption of the carbons is decreased fully one-half, thus making them burn twice as long as they ordinarily would, so that a single pair of carbons can be made to burn through an entire night, or as long as a double carbon lamp of the usual construction. The inventor is unable to account satisfactorily for the beneficial effect of the shield. He states that the large increase of durability is a practical result demonstrated by repeated trials of many hours and days duration.

DEAD BEAT GALVANOMETER.

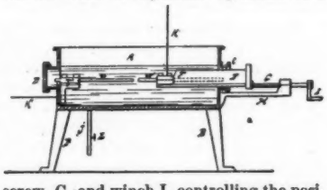
The accompanying engraving illustrates an improvement in galvanometers recently patented by Thomas Harris, of Detroit. It



comprises a light filament of magnetic material, as, for example, a soft iron wire suspended in a solenoid *A*. The solenoid is inclined at an angle of 45 degrees and the needle is suspended by a silk fibre from the upper edge so as to hang substantially in the vertical axis of the tilted coil. The coil is flattened and somewhat wedge shaped in cross-section, as illustrated in the detached view, and a very light aluminium index *D*, is secured to the needle, a scale plate *E* being secured to the frame in the path of sweep of the index. When a current passes through the solenoid, the iron filament or needle is rendered magnetic, and as the direction of the current through the coil is not at right angles to the position of the magnetic filament, the latter, in accordance with the law of Oersted, tends to move into such position. This tendency, owing to the manner of suspending the filament, produces a deflection from its normal position, the opposing force being gravitation, tending to hold it in a perpendicular position. In view of the fact that the needle advances towards an axial position with reference to the coil, the amount of torque becomes of decreasing value, and unless other provision was made, the scale plate would have to be irregularly graduated. This difficulty is, however, avoided by making the coil wedge-shaped, so that as the needle approaches an axial position it will come into closer relation to the coils of the solenoid. This shape of the coil also counter-balances the increasing value of gravitation as the needle is deflected from its vertical position. The number of windings and kind of wire depends upon the character of the currents to be measured. For the convenience of reading the scale the solenoid is so inclined that the filament under deflection will move to the right. Lightness of the magnetic filament and index enables it to respond very quickly to a change of current and assume its position of deflection with reference thereto without oscillating, thus making it practically dead beat.

WELDING UNDER WATER.

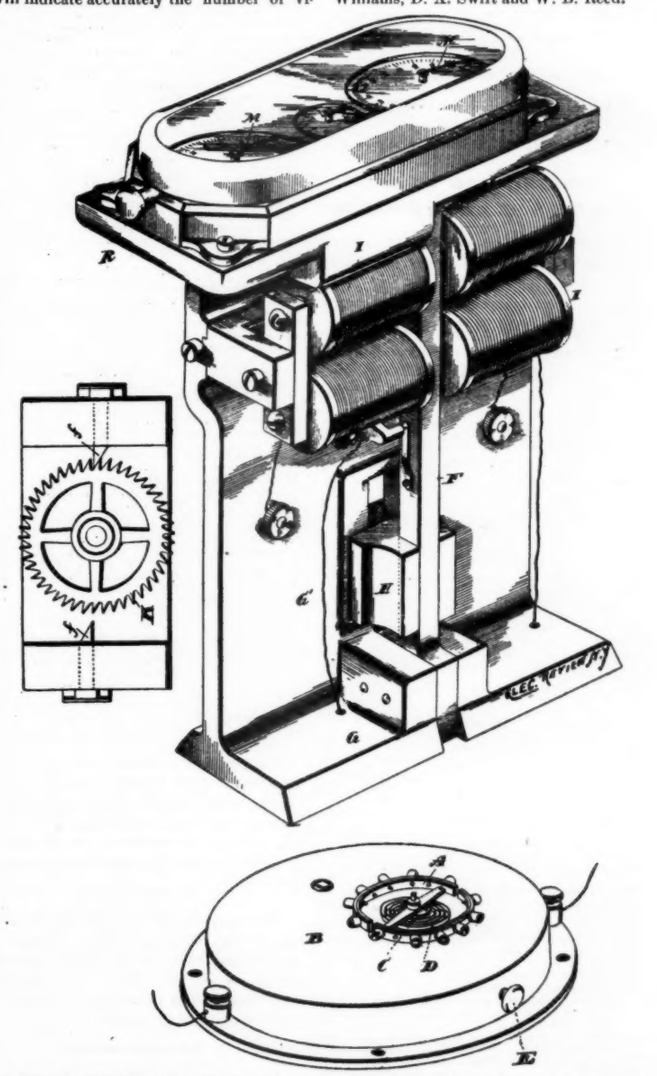
In the accompanying engraving is illustrated an improvement in electric welding which is the invention of Charles L. Coffin, of Detroit. The welding operation in this system is performed under water, which is claimed to prevent the formation of scales upon and near the two pieces of metal which are being operated upon. In a suitable vessel are placed clamps, F, F^1, for holding the pieces of metal to be welded. The heating current is led through conductors, K, K^1, to these clamps. One of the clamps is fixed and the other is adjustable by means of a



screw G and winch I, controlling the position of the clamp F, which slides through a stuffing box in the side of the vessel. The articles to be welded, W, W^1, being set in clamps the box is filled with water so as to submerge the metals, and the ends of the latter are brought into contact and an electric current passed through them, or they may be slightly separated so as to form an arc between them, and when brought to a welding heat may be pressed together by means of the adjusting screw.

ELECTRICAL SELECTION OF WATCH BALANCES.

In the accompanying engravings we illustrate apparatus invented by Messrs. Hunter & Corthill, of Elgin, Ill., by the use of which the rate of vibration of hair-springs and balances may be determined to a very fine degree, it being claimed by the inventors that an error in a watch balance of one second in twenty-four hours can be indicated by the apparatus. The principle of the invention involves the simultaneous operation of a vibrating reed of high pitch and the watch balance, the two being released at the same instant by electrical agencies, and stopped at the same instant by the same means. The pitch of the vibrating reed is capable of accurate graduation of adjustment to a standard tone. The instrument is provided with registering mechanism for recording the number of vibrations of the reed. A balance which it is desired to test is placed upon a post C, operated by an ordinary watch movement, and provided with a standard hair-spring D. The movement is normally restrained from operation, and is adapted to be thrown instantly into action by a push button E, and when so released the time train will run until a certain number of vibrations have been made by the balance, when further movement will be automatically arrested. The vibrating reed F is kept in continuous motion by means of rheotomic apparatus for alternately closing the circuit of a pair of magnets on either side of the reed. Its pitch is adjusted by moving a damper H to the proper point, when its tone will correspond with a standard tuning fork. The reed operates by means of pawls *f f*, see the detached figure, to release an escapement wheel K, actuated by a weight or spring, one cog at a time, and the registering mechanism can be connected with, or disconnected from the wheel K by means of an electro-magnet—not shown—the circuit of such electro-magnet being controlled by the same push button E which controls the movement of the balance wheel. From this it will be understood that the reed F can be first adjusted to a definite pitch so that its number of vibrations can be known. A balance which it is desired to test is then secured upon the post C, and the releasing push button E is operated, thus throwing both the registering train and the balance into simultaneous operation. The watch movement B is adjusted to open the circuit closed by the push button E, after a definite number of vibrations have been made, after which time an inspection of the register M will indicate accurately the number of vibrations of the reed during the time the balance was in operation, which number, compared with the corresponding number for a standard balance, will indicate the amount of error in the balance tested. In testing a hair-spring, precisely the same mechanism is employed, except that a standard balance instead of a standard hair-spring is secured upon the balance arbor, and provision is made for the ready adjustment and removal of the hair-spring to be tested instead of the balance, as heretofore described. The number of vibrations made by the reed magnifies the error of the balance so that it can be very easily noted on the register, even a small fraction of a single vibration of the balance producing a wide divergence in the position of the registering indicator.



Pittsfield, Mass.—The Pittsfield Electric Company, to manufacture electrical apparatus; capital, $25,000.

Chester, Pa.—Rapid Transit Passenger Railway Company, to build an electric railway between Chester and Media; capital, $100,000. The president of the company is J. Watts Mercur.

Little Rock, Ark.—The Texarkana Gas and Electric Railway Company; capital, $500,000. Officers, J. Deutschman, president; B. Collins, vice-president, F. W. Oppenhauser, secretary.

Indianapolis, Ind.—West Indianapolis Electric Light Company; capital, $20,000. Directors: John S. Crosby, John W. Mitchell, T. S. Graves, James B. Wilson, J. C. Williams, D. A. Swift and W. B. Reed.

Milwaukee, Wis.—Automatic Phonograph Company; capital, $3,600. Hugh Ryan, William C. Atwater and W. S. Burnett are the incorporators.

Atlanta, Ga.—Atlanta Electric Illuminating Company; capital, $100,000. Officers, Mr. H. Atkinson, president; H. T. Inman, vice-president; G. R. DeSaussure, secretary; W. H. Rhett, general counsel. Directors, H. T. Inman, John Ryan, T. L. Langston, A. E. Thornton, J. W. Rucker, Peter G. Grant, W. H. Inman, A. V. Gude, J. L. Hopkins, H. M. Atkinson and Walter H. Rhett.

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The president of Liberia has signed a decree assuring an English company the exclusive right to export gum, caoutchouc or gutta-percha from the territory of the republic; a penalty of $5,000 to $10,000 will be imposed on any other party exporting these substances.

The heavy storms of last week played havoc with telegraph wires. Boston suffered considerably, the Western Union office being set on fire. New York messages were delayed only a short time. Everything is working normally again.

During the Street Railway Convention at Buffalo, one of the speakers stated that it took about three months of very careful handling to fit green horses for street car work. President Lowry, who is arranging for one of the largest electric railway plants in the country, remarked that he would have about 2,000 of these "acclimated horses" for sale at a low figure in a very short time, and, in reply to a question from Deacon Richardson, of Brooklyn, agreed to deliver them in New York at a cost 25 per cent. less than the current price. It would seem that the street car horse will soon be able to take a long and well earned rest.

President Thomas Lowry, in his address to the street railway men, made the following prophetic remark: "I am so thoroughly convinced that electricity is the coming power for street railways * * * that I believe this is the last Convention that will ever seriously consider horses for the operation of street railways."

William M. Chase, in a recent article on portrait painting, written for the New York *Herald*, says: "A fact that may not be generally known is that Samuel F. B. Morse, the inventor of our telegraph, was a magnificent portrait painter. There is a superb work of his—a portrait of Thomas Jefferson, in the City Hall—which might have been painted by Franz Hals."

It proved a very difficult job a year or two ago for an English company to persuade his barbaric majesty Muley-el-Hassan to allow them to land a submarine cable at Tangiers, the chief port of his extensive, if uncultivated, dominions. The point was eventually gained, partly by strategy and partly by persuasion, and the telegraph has at least landed in Morocco, although it has not penetrated into the interior. Now China is posing as an antagonist of the telegraph. Cables have long been landed on her shores, but quite lately an agreement was entered into between the Chinese government and the telegraph companies for an extensive system of land lines which would allow of a general simplification and lowering of rates. The viceroy, Li-Hung-Chang, however, decided that such an agreement, although it carried with it a substantial indemnity to be paid to the government, was unworthy of the dignity of the "Son of the Heavens" and refused to ratify it. Consequently, matters rest in *statu quo ante*, and China continues to form an immense barrier to the development of the telegraph in the far East. Apropos of this stubborn attitude on the part of the Chinese, *La Lumière Electrique* remarks: "Are we not right in saying that by the study of electrical institutions the best judgment may be formed of the degree of civilization which a country has attained?"

A NEW STANDARD OHM.

We presented in the the last issue of the REVIEW a very able paper by Prof. Glazebrook, on the absolute determination of the ohm, read before the recent meeting of the British Association. In the discussion which followed the paper, and which was participated in by Professors Rowland and Barker, of the United States, and the leading British scientists, a very general desire was indicated to change the present standard of the unit known as the legal ohm—the resistance of a column of mercury of one square millimetre cross-section and 106 centimetres long at 0° centigrade—to a column 106.3 centimetres in length, which is more nearly the true value of the ohm as determined by a large number of tests.

BOOK NOTICES.

The Leonidas *Telephone* is the name of the latest arrival in the field of Michigan country journalism.

Whipple's Reports begins the second volume with the October issue, in a larger form and with a slate-colored cover. It is a decided improvement.

The unusual feature of an article written, drawn and engraved by the same hand, will appear in "A Day with a Country Doctor," by Frank French, in the November *Scribner's*.

"Bureau of Statistics of Labor; Resumé of Strikes for Five Years, 1885-89," has been received from Hon. Charles F. Peck, the commissioner in charge of the work. It is a valuable and comprehensive volume.

Rufus Fairchild Zogbaum, in the November *Scribner's*, defends the officers of the "White Squadron" from the charges of undue severity of discipline which have been circulated by the newspapers. "To those cognizant of the true conditions of affairs on the fleet," he says, "some of these reports would be almost comical in their absurdity, were it not for the false impression they are calculated to convey to the mind of the public."

THE BUFFALO CONVENTION.

The Convention of street railway men at Buffalo last week was a large and spirited one, electric traction leading as the topic of discussion. A full report of that part of the programme appears in the REVIEW.

This is good evidence of the progressive spirit of the times, that the representative men in the extensive field of street car traffic should have so promptly taken up with the new power—electricity—and the eagerness displayed at Buffalo for complete and practical information, was particularly noticeable. The inventors of new apparatus were all accorded a hearing, and the men experienced in running electric railways were constantly being interviewed by those who had not yet adopted the new power.

The manufacturers of electric railway systems were present in persuasive force, and every opportunity given to the delegates for thorough investigation of all claims,

The Convention was a very successful one, and, we think, marks a very progressive step in passenger traffic and in the advancement of electrical traction.

THE BLIND LEADING THE BLIND.

In the course of his address to the meeting of the Brotherhood of Locomotive Engineers, held recently, at Pittsburgh, Mr. Depew made the following curious remarks touching on the heroism of locomotive engineers: "The true locomotive engineer is always a man of sense, of quick thought and courage in an emergency, and in peril a hero. * * He sees the tottering bridge, the obstruction on the track, the open switch. The opportunity is before him to reverse and jump or to stick to his engine and perform his duties. In 99 cases out of 100 he utters a brief prayer, bids a mental farewell to his wife and little ones at home, and rescues his train or goes calmly to his death."

This is, no doubt, a very graphic picture of the perils to which locomotive engineers are exposed and of the manner in which they confront them, but surely Mr. Depew, as president of a great railway system, rather "gave himself away," so to speak, in dwelling so emphatically and explicitly on the perils to which the passengers who travel behind the heroic engineer are, with him, exposed. It is true, no doubt, as stated by Mr. Depew, that hundreds of passengers are often saved from hurt or death by the presence of mind and sagacity of the engineer, but when the public is informed by the most prominent railroad president in the country that "the tottering bridge, the obstruction on the track, the open switch" opening suddenly on the vision of the engineer are matters of common occurrence in railroad travel, and that the lives of the passengers depend chiefly on the quickness with which the engineer grasps the situation and applies the remedies, we do not suppose, in spite of the matter-of-fact manner in which Mr. Depew referred to this phase of railway life, that he really meant it to be inferred that travelers are so frequently in peril of life and limb as his words seem to indicate. Besides, the tottering bridge, the obstructed track and the open switch are not responsible for so very many railroad wrecks as to justify their mention as the principal causes of the too frequent disasters on our railways.

We have often pointed out before that to the apathy with which railroad officials regard the adoption of proper systems of signals, and to the low efficiency in which they maintain their telegraph plant may be traced many of these disasters which have no right to the name of accident. Electricity can lend powerful aid in the management of large railway systems; in fact, it is the only agent which can secure the maximum of safety to the traveling public. If the New York Central were to adopt the block system of signaling, there would be no necessity for Mr. Depew to inform the public that its safety is chiefly entrusted to the locomotive engineer, and the occasions on which this individual is called upon to rescue his train or go "calmly to his death" would be far fewer in number than they are at present.

CORRESPONDENCE.

OUR BOSTON LETTER.

The Tropical American Telephone Company was in receipt of several large orders during the past week. General Manager J. H. Howard reports a steadily increasing demand for telephonic apparatus from cities and towns in South and Central America and the West Indies.

The Erie Telephone Company through its treasurer reports a gain of 277 subscribers for the three months ending September 30th. The total number of subscribers on the date named is said to be 12,939.

Mr. Edgar D. Swett, contractor and builder of telephone and telegraph lines and dealer in poles and telegraph material, has just completed a line from Woonsocket to Providence, R. I., for the New England Printing Telegraph Company.

Electrical Mining has already become an important branch of the business of the Thomson-Houston Motor Company. Owing to the rapid strides made by the company in this enterprise, General Manager H. C. Spaulding will hereafter devote his time exclusively to that branch; and Mr. R. C. Wiggin will assume active charge of the company's stationary motor business.

The Electrical Forging Company has been incorporated at Portland, Me., with a capital stock of $2,000,000, for the purpose of manufacturing and operating electrical apparatus. Frank E. Peck is president and F. J. Hutchinson, treasurer.

The Eastern Electrical Supply and Construction Company, recently established in this city, held a meeting October 15, and elected the following officers: President, Maybin W. Brown; vice-president, C F. Hutchinson; secretary, Josiah H. Drummond, Jr.; and treasurer, Albert Otis Smith. The above named gentlemen and Messrs. L. A. Dean and Samuel R. Moseley, comprise the board of directors. The above named company has shipped this week a large order of electric supplies, including a number of Burnley dry batteries, to Paris, France.

Mr. George R. Blaisdell, formerly with the Thomson-Houston Electric Company, and one of the best known and most proficient stenographers in this section, has established offices at No. 79 Milk street, where he will be pleased to receive business or friendly visits from his electrical acquaintances. Mr. Blaisdell is building a magnificent apartment house in Chelsea, Mass., which will overlook Boston harbor, East Boston, Revere and Malden.

Another New Electrical Enterprise.—It is reported that arrangements are on foot for the formation of a company for the manufacture of electrical apparatus and appliances at Pittsfield, Mass., with a proposed capital stock of $25,000. The company will manufacture electric machinery, and it is probable that application for a charter will be made within a week or two. The persons interested in forming the company are yet undecided where they will locate.

The Russell Arc Lamp in Canada.—Messrs. E. C. Russell and Abram Hoffecker report having sold their joint patent in the Russell Arc Lamp to Canadian capitalists for $60,000, reserving for themselves a stock interest in the new concern, which will be known as the Craig-Russell Electric Company. Mr. Russell stated recently that it is his intention to dispose of his European patents at an early day.

Inspector of Electric Wires.—At a meeting of the Boston aldermen, early in the present week, an ordinance regarding the supervision and regulation of electric wires was presented, discussed and assigned to the next meeting. Section 1 provides that the mayor shall appoint, subject to confirmation by the board of aldermen, an inspector of wires, who shall receive a salary of $3,000 a year.

New England Electric Exchange.—The regular quarterly meeting of the New England Electric Exchange, adjourned over from Monday, October 13, was held at No. 620 Atlantic avenue, Boston, Tuesday afternoon, October 14. The quarterly reports of the secretary and treasurer, together with license statement were read and accepted. It was voted to have the electric welding process rank on an equal footing with electric lighting and electric power in qualification for licensing. A committee, consisting of the president of the Exchange and Messrs. C. B. Burleigh and J. R. Lovejoy, was appointed to confer with a committee of the Insurance Exchange regarding revision of the rules for wiring. The resignation of Mr. H. C. Spaulding as secretary and treasurer, was accepted, and Mr. Timothy W. Sprague was elected to fill the vacancy. Great interest is being manifested, and steadily on the increase, in taking out licenses. There seems to be a lack of interest among the members of the Exchange in attending the meetings, which surely ought not to be.

W. I. B.

Boston, October 18.

Electric Lighting Many Times Superior to Gas.

BY PAUL HOHO.—A PAPER READ BEFORE THE SOCIÉTÉ BELGE D'ELECTRICIENS.

At a conference which took place in connection with the last general assembly of the Union of Engineers, graduated at the University of Louvain, I had occasion to make a comparison between certain figures relative to the yields of an electric incandescent lamp and a jet of gas. I was greatly surprised at the astonishment which my conclusions evoked, even amongst electricians; and I was induced thereby to repeat my calculations in our society with a view to raising a discussion so as to accentuate the affirmative character of the conclusions which might result. In any case, it is well to proclaim aloud, and to reiterate figures which ought certainly to find a place on the leading page of every engineer's pocket book. The matter is one of extreme simplicity, and, frankly, I ought to apologize to you for introducing one so elementary.

The entire question reduces itself to this: What amount of energy is required by an incandescent lamp on the one hand, and a gas jet on the other, in order to produce an equal amount of light; for example, an amount equivalent to 16 candles?

Allow me to make a slight digression for the purpose of assisting somewhat in preparing gas for the sentence which is about to be pronounced upon it by figures which admit of no appeal.

The action of the incandescent lamp is based upon the fact that the energy of the electric current, in traversing its filament, is transformed, by reason of the resistance offered by the latter, into calorific energy, which emanates from the filament in the form of calorific rays. But, as you are aware, a solid body, if placed in a certain temperature, becomes incandescent; that is, a part of the calorific rays becomes luminous.

For the complete utilization of this property, it would be necessary to attain to such a temperature that the proportion of the luminous rays to the total radiation is the maximum. Unfortunately, the physical constitution of the filament, as we actually possess it, does not admit of its being placed above a certain temperature, and we are compelled, therefore, to moderate the action of the electricity in the lamps. The incandescent lamp, as far as it goes, is consequently very far from realizing our ideal, and in order to bring about its perfect action upon this principle, electricity is compelled to await the progress of chemistry, which I hope will one day give us a body upon which electricity will be able to exercise its action without restraint. I will not expatiate upon what may be reasonably expected by electricity upon this head, but will base my calculations upon results as they have been actually obtained.

As regards the gas jet, I would first of all remark what a singular idea was that which sought to light up the universe by means of a flame. A flame, as you are aware, is essentially composed of gaseous elements, in which is found a comparatively slender quantity of solid particles. Now, we learn by physical science, that from gas, at whatever temperature it may be carried, emanates very little or no light; all its rays are calorific, and the light which emanates from the flame, is exclusively composed of solid particles, notably carbon.

Is it possible to imagine a more irrational method of lighting? You may attempt to excuse it by saying that it has for a long time been the only one we knew. I admit the excuse, and even that it is a serious one, but you must also confess that it is the only one.

A priori, we are in a position to foresee the wretched result to be had from a gas jet; and it only remains to compare the figures.

An incandescent lamp of 16 candle-power consumes at its terminals 2, 2½, 2½, 3 to 3½ watts per candle, or 32, 36, 40, 48 to 56 watts for every 16 candles, which amounts to 3.2, 3.6, 4, 4.8, 5.6 kilogrammetres per second for every 16 candles.

On the other hand, a 16 candle-power gas jet consumes 180 litres and more per hour.

Now, a cubic metre of gas, by its combustion, gives out 6,000 calories (according to M. Fresca's calculation); and 180 litres will give out $6{,}000 \times \frac{180}{1{,}000} = 1{,}080$ calories; 1,080 calories = 1,080 × 424 = 457,920 kilogrammetres, which a gas jet consumes per hour, that is $\frac{457{,}920}{3{,}600} = 127.20$ kilogrammetres per second.

It only remains now to compare this consumption of energy with that of an incandescent lamp, as set out below.

$$\frac{127.20 \text{ kilogrammetres}}{3.2} = 39.75;$$

$$\frac{127.20 \text{ kilogrammetres}}{3.6} = 35.28;$$

$$\frac{127.20 \text{ kilogrammetres}}{4} = 26.50;$$

$$\frac{127.20 \text{ kilogrammetres}}{5.6} = 22.70.$$

From these I conclude that in order to produce a luminous intensity of 16 candles, a gas jet consumes 22.71 to 39.75 times more energy than an incandescent electric lamp, counting the latter at 2 to 3½ watts per candle, and the consumption of gas at 180 litres per hour. I conclude, further, that the incandescent supplies an illumination absolutely 22 to 40 times that of a gas jet.

That is all I had to prove, and I could content myself with pointing out that in order to destroy these conclusions, it will be necessary to invalidate the preceding figures, which is, I repeat, impossible. However, as I foresee myself being answered in the eternal refrain of "theory and practice," I will dwell a little longer upon the matter than it really demands.

In the above conclusion I have specified all that the figures teach; they tell us nothing more, but, above all, nothing less. We, therefore, have it that the incandescent lamp constitutes a transformer for the production of luminous energy 22 to 40 times more perfect than the gas jet, comparing the two individually without regard to the production of energy by the one or of gas by the other. This is the first thing to be established.

Next, as regards the production of electric energy and the production of gas.

Energy is present in nature under various forms; under that of chemical energy in carbon and other bodies—as calorific energy, as the energy of gravitation and of masses in movement; for example, the fall and flow of water.

Gas can only be obtained from coal, and, in certain cases, where it already existant in nature, whilst it cannot be drawn from energy which exists in other forms, unless in the most roundabout and impossible way.

Electric energy, on the contrary, may be obtained by the transformation of energy existing in any form, with various results. Thus coal may be transformed into electric energy by a series of transformations yielding a feeble result, which is successfully diminished by each transformation; the mechanical energy which may be employed upon a shaft moved by a fall of water, may be transformed into electric energy and afford results unknown in any other industry, 85, 90 and even 93 per cent., for instance.

Therefore, in comparing electricity with gas, it would be absolutely unreasonable to deal with energy as existing under one form only.

If gas, for the sake of a cause which is otherwise indefensible, demands that the comparison be made from the standpoint of the energy of coal compared with that of gas, electricity will not shrink from the comparison; but should electricity in its turn call for a comparison with other forms of energy, the protests of the advocates of gas would only be equalled by the disastrous results to their client.

However, for the production of light, it suffices on principle to have a suitable transformation of energy, nothing but energy, and this as much as possible free from carbon fumes and from the emanations of carbonic acid and other similar products whose influence is little beneficial. It is true that coal is to be found in large quantity in nature, and that in this country, as a rule, it offers the most economical and convenient form of energy for our needs. But we are not merely arguing the case of Brussels, and without admitting the hypothesis that some day or other we shall have to make use of the Niagara Falls, we have still in this country waterfalls and flows which could be easily utilized, and which have, in fact, been so very frequently.

We by no means decline to institute a comparison with gas on the standpoint of coal or of gas even, but first let us point out the insufficiency and exclusiveness of the comparison.

Thus, ten kilos. of coal furnish a maximum of 3,000 litres of gas, or a quantity sufficient to feed ten jets of 16 candle-power during one hour and 40 minutes. To produce electric energy from coal, we are obliged in the first place to transform, by a series of transformations, the energy of coal into mechanical energy and next into electric energy. With the aid of a good condensing engine, ten kilos. of coal will furnish eight horse-power hours upon the shaft, by means of which the dynamo electric machine will furnish eight horse-power hour × 75 kg. × 9.8 w. × 80 per cent. = 4,800 watt hours, or the amount of energy necessary for supplying ten incandescent 16 candle lamps during 8½ to 15 hours.

Result in favor of electricity:

$$\frac{8\frac{1}{2} \text{ to } 15}{1\frac{1}{2}} = \frac{5\frac{1}{2} \text{ to } 9}{1}$$

and, moreover, the first transformations of the energy, up to the driving shaft, before electricity had come into play, had only furnished a total rendering of ten per cent.

In fact, 1 kilo. of coal gives an immediate yield of 5,000 calories — 2,120,000 kilogrammetres, whereas, upon the driving shaft we have 0.8 horse-power hours × 75 kg. × 3,600 *s* — 216,000 kilogrammetres, which gives a rendering of

$$\frac{216{,}000}{2{,}120{,}000} = 0.10 = 10 \text{ per cent.}$$

Let us now make the comparison on the score of gas, that is, by employing the 3,000 litres of gas produced by 10 kilos. of coal on the one hand directly in the gas jets, and on the other for producing, by means of various transformations, electrical energy for the supply of incandescent lamps. The 3,000 litres of gas will supply, it is said, 10 jets of 16 candle-power during one hour and 40 minutes. On the other hand, they will supply upon the driving shaft of a gas motor $\frac{3{,}000}{700} = 4.286$ horse-power hours, by means of which the dynamo will furnish 4.286 horse-power hours × 75 kg. × 9.8 w. × 80 per cent. = 2,560 watt hours, or the amount of energy required for supplying ten 16 candle incandescent lamps during 4½ to 8 hours.

Result in favor of electricity:

$$\frac{4\frac{1}{2} \text{ to } 8}{1\frac{1}{2}} = \frac{2.74 \text{ to } 4.8}{1}$$

And, moreover, the gas motor, which consumes 700 litres of gas per horse hour only returns 15 per cent. yield. In fact, 700 litres of gas give immediately

$$\frac{700}{1{,}000} \times 6{,}000 = 4{,}200 \text{ calories} = 4{,}200 \times 424 = 1{,}780{,}800 \text{ kilogrammetres;}$$

whilst on the driving shaft they gave 75 kg. × 3,600 = 270,000 kilogrammetres, or

$$\frac{270{,}000}{1{,}780{,}000} = 0.15 = 15 \text{ per cent.}$$

These figures point their own conclusions sufficiently clearly, precisely, explicitly and instructively, to be developed by us.

I have only to point out what follows as a consequence:

1. The loss which occurs in obtaining electric lighting by means of coal or gas is not to be attributed to electricity but to the successive transformations of energy with very slender results before electric energy is obtained.

2. Directly electricity comes into play, that is when mechanical becomes transformed into electrical energy, the yield is enhanced to 80 per cent. (as mentioned in my calculation), and may in fact reach to 85, 90 and 93 per cent., and more.

3. Therefore, in spite of the preliminary very unfavorable tranformations of electricity, a total result is obtained which is notably superior to gas, as I have shown in the foregoing figures.

These will be found to gain in importance and to accentuate the advantages of electricity if we take into consideration the following three facts:

1. The transformation of energy in general in all these forms makes continuous advances. Whilst these advances constitute an immediate advance for electric lighting, they bring with them no advantage for gas lighting. It is true that gas is in no way prejudiced by the transformations undergone by it before its utilization, but its failure consists entirely in its employment as a lighting medium.

2. The transformation of electric energy is making rapid progress. The same cannot confidently be said of gas, which after over 100 years of use, finds itself already outstripped by a luminant which hardly counts an existence of 10 years.

3. Electric energy is peculiarly transportable from long distances, a fact which enables it, and will enable it, to overcome local circumstances disadvantageous to its production, by enabling its production in localities where the conditions are more favorable.

Fire in the Western Union Office at Boston.

The Western Union Telegraph service in Boston was damaged by fire October 19th. An electric light wire was supposed to have been blown down by the wind and crossed a telegraph wire.

The New York, Western and Southern wires were burned out, and a fire was kindled which required the services of the fire department. The fire was quickly subdued, but the water which poured down the shaft connected all the wires and rendered them useless for service. The wires on top of the building were repaired in a few hours, but the water behind the switchboards could not be removed before morning and the service was crippled during the night.

Telephonic News

*** The Pennsylvania Telephone Company has concluded to build a new line between Allentown and Easton, Pa.

*** It is said that there are about 25,000 telephones in use in Canada, of which number 20,000 belong to the Bell Telephone Company.

*** The Bluffton, Ind., telephone exchange is being rebuilt, and Goshen, Huntington, Wabash, Plymouth and other points are to be connected.

*** The New England Telephone and Telegraph Company is putting up a metallic circuit on their telephone line between Portland and Auburn, Me. When completed, communication with Boston will be established.

*** The telephone company at the port of Manila has decided to open a floating telephone station in the harbor, so as to allow persons on board vessels at anchor in the harbor to communicate with persons in the town without going on shore.

*** Work was commenced at St. Paul, Minn., last week, in laying the telephone wires in the underground conduits. Already 6,000 feet of cable has been received and 30,000 feet more is on the road. It is expected to finish the work by December 1.

*** The life saving station at Fairport Harbor, O., has petitioned the government for a telephone. There is no place, it is said, where telephonic communication is more necessary, or where a greater good could be accomplished with so little expense.

*** A French company has just obtained a concession from the Russian government for the setting up of a telephone between St. Petersburg, Moscow, Warsaw and Berlin. The charge for using this telephone is to be two roubles the first minute and a rouble for every minute after.

*** The Hudson River Telephone Company has not given up the fight against the Watervliet Turnpike and Railway Company, of Albany, N. Y. Exceptions to the report of Referee Lawson, confirmed by the General Term, were filed on October 8th, by D. Cady Herrick, counsel for the plaintiff. He excepts especially to the conclusions of law contained in the report. The matter will now be carried to the Court of Appeals.

*** A resolution was passed in the Orange, N. J., Council, recently, granting permission to the New Jersey Postal Telegraph Company to string wires on the poles of the Essex Company from the West Orange line to the East Orange line. Another resolution was passed instructing the city counsel to notify the New York and New Jersey Telephone Company to remove its wires from the top arm of its poles, on account of the trouble caused by the telephone wires crossing those of the fire alarm system.

*** With the close of the present season the sub-companies of the Erie Telephone Company will have completed over six miles of underground conduit covering the thickly settled portions of the cities of St. Paul, Minneapolis and Cleveland. Into the conduits has been drawn nearly 70,000 feet of 125-wire cable. This work when finished will give the Erie's sub-companies a complete underground system in the cities mentioned and supply all demands for this work for a long time to come. The large poles and wire removed will be shipped to and used in other sections of the company's vast territory. In addition to the above work, the Minneapolis, St. Paul and Cleveland offices have been equipped with the latest improved multiple switchboards at a cost of $50,000, the old boards having been remodeled and shipped to smaller exchanges. The cost of the underground work and new switches will be about $150,000.

STREET RAILWAY CONVENTION.

(*Continued from page 102.*)

nical details, would occupy too much of your time. The subject naturally divides itself into: 1. The central station. 2. The transmitting line. 3. The motors.

The National Electric Light Association has so fully and exhaustively considered the matter of power or central stations, that, most fortunately for street railway men, this subject is one that troubles us but little; but there are some points in which our work differs materially from that of an electric lighting station.

The engine we require must be strong in all its parts, for there is no work where the demands on it vary so suddenly and so frequently, from the entire absence of load to the extreme capacity of the engine, as in street railway work. Some roads report that the cars average but five horse-power each; supposing that such a road has eight cars in operation with one 150 horse-power engine in the station, and, as is often the case, the cars either become bunched or happen to start at the same instant; here a sudden demand is made upon the engine for 150 or 200 horse-power, while a moment later the meter may register but 40 horse-power. You will, of course, be provided with safety plugs and current breakers, but you cannot allow safety strips to be blown out half a dozen times a day, possibly just at the moment you are ascending a heavy grade.

Electric light men state that a station with a number of small high-speed engines is more economical on account of being more flexible in its operation, but in their business the loads upon the station vary gradually, while we may be called upon at any moment for our maximum capacity. To arrange our station for this varying load, and at the same time avoid operating a tremendous engine on an average light load, is a problem that experience must solve for us. We are also more greatly troubled with lightning than we should be. There should first of all be established as perfect a ground connection as possible, either by means of a well or a deep hole. It is better to have two grounds, and thereby make sure of a moist contact for galvanized ground-plates or rods; then with proper lightning arresters so placed that they can be conveniently examined and kept in order, we will be fairly well protected; but with our great lengths of exposed trolley wires we are very certain to have frequent calls upon our lightning arresters, and those in use at the present time are not such as to warrant perfect confidence.

Are we not all personally firm believers in the overhead system of transmission? What can there be simpler, cheaper, more durable and more convenient? We have only poles, bare copper-wire, galvanized iron span wires, insulators and, where needed, additional feed wires, of which these last can be placed underground if desired. It is a rare thing to have a trolley break, except at the curves. Curves are certainly troublesome on account of the constant liability of trollies to jump off at some sharp angle, and the trouble is more generally due to faulty trolley stands, wheels or springs, than to the overhead wire. For insulators we have only those for the straight line and those for the curves; and I show you a sample of each, such as were used two and a half years ago on one of our lines. It is not to be wondered at that street railway men at that time considered electricity, for the rough usage required by street railway work, to be in an embryonic stage of development. There is little to be asked for in the way of improvement of what we now have for overhead material. There is practically no difference whether we use the Thomson-Houston system, Edison-Sprague, Westinghouse or what not. A single trolley wire which may be large and heavy, say 00, and thus avoid feed wires where distance is not too great, or the wire may be small, say, No. 4, light and easy to handle with, in that case, the necessary feed wires. We can take our choice and find equally good results with either. It will often be convenient to utilize both plans, with the large trolley in the central parts of the city where feed wires might not be desirable, and with the small overhead and feed wires to reinforce the suburban parts. Undoubtedly, the small wire is more easily handled and repaired in case of a break, and the feed wire prevents a dead line being the result of a break. The rail bonds may be galvanized iron, which costs but four cents, instead of tinned copper, and the supplemental ground wires can be of the same material. The supplemental wires do not give any better returns, except so far as to prevent a bad break in the return circuit, which might occasionally be caused by the breaking of both rail bonds at neighboring joints. Rails on both sides of track should be connected with bonds.

It will not be necessary to discuss the merits of the conduit system or the storage battery. Actual experience has proven that there need be so little trouble or danger from the station and overhead line that we cannot concede the need of either conduit or storage battery, so far as *we* are concerned. It is true that the ever-restless mind of the public has been so stirred up by accounts of the numerous successful storage battery and conduit railways, that it has suddenly (and to us most unpleasantly) become aware of the fact that we are using *poles*, and while we are congratulating ourselves upon the beauty and symmetry of our neat line of poles, it suddenly demands that we remove what it terms our unsightly poles. Nearly every one of the street railway men present will uphold the statement that the only problem before us, and the one about which we are always anxious, is, "What can we do to keep our motors out of the repair shop?" We don't worry about our station or our overhead wires; we scarcely have time to think of them; we are constantly at work upon and perpetually annoyed by our motors; a lame armature, a burnt field magnet, a broken gear, these are our every day trials. A motor, such as is made by the Thomson-Houston, Edison-Sprague or Westinghouse companies, has among its mechanical parts an axle gear and intermediate shaft gear, shaft pinion and armature pinion, and the axle and intermediate shaft and armature have each their boxes or bearings. We want gear and pinions to be wide and heavy enough not to break. We don't want any more pinions like this, which was in use two years ago. We want gear of some material that will be reasonably durable, and at the same time noiseless; cast iron may do for the axle gear, which is large and runs slower, and steel for the intermediate shaft pinion; steel, we believe, is better than bronze, as it lasts longer and is less expensive. To overcome the noise it is necessary either to have the gear covered and running in oil, or to have the gear of wood or the pinion of raw hide. The large gear on the axle and intermediate shaft, if made with wooden teeth and used with steel pinions, certainly runs noiselessly, and it ought to make the life of the pinions much longer. Care must be taken to have the keys in all gear and pinions, tight and self-retaining. The shaft boxes and bearings must be made of some compound metal that will not wear out too fast, for but little wear on the armature bearings will allow the armature to scrape on the pole pieces of motor, be damaged and laid up for repairs. Aluminum bronze gives satisfaction as material for the bearings.

The electrical parts of the motor in which we are most interested are the armature, field magnets, and the controlling switch or rheostat. The armature of an electric motor is its most wonderful and interesting, as well as its most expensive and troublesome, part. A street car is the most overloaded vehicle known to mankind. It may run a week with a light load, and then suddenly receive enough passengers to load fairly well three or four ordinary cars; the motorneer may forget to oil either the car or motor, he may reverse motor accidentally or purposely to avoid an accident; these and many other causes require of an armature more work than it is capable of, hence a burn-out. On the other hand, the armature itself may be at fault; an armature such as we use to day consists of a shaft surrounded by a metallic core. Around this core is wound the best insulated wire, each coil terminating at the same end of the armature and being attached there by means of solder or screws to the bars of the commutator. The shaft of the armature will in a few years become worn by its bearings, and it would be well to have bushings or sleeves placed around shaft at those points, such as the Thomson-Houston Company use, which sleeves can be removed. As there is no wear to the core, and as the commutator can be renewed when worn down, which ought not to occur in less than two or three years, an armature should then have as long a life as one could desire, were it not for the coils of wire. Where these coils cross around the head of the armature they chafe on each other and destroy their insulation. Where they end in the commutator they loosen; by an excessive load or careless driver they burn out. It may be possible to repair the armature by rewinding one coil or by re-fastening the loose ends, and even when a deep coil is burnt, the total rewinding with new wire should not cost but 40 or 50 dollars. Could we but prepare for the burn-outs by having the car on some side track near the repair shop where it would not interfere with our running time or cause a hindering of cars, we would not feel so aggravated, but it happens invariably at the time we need every car most urgently. We can watch our gear and bearings, and when worn they may be replaced at our convenience or at night, but an armature gives out without warning. It is on this account that these systems advocating but one motor to a car, must give us positive assurance of *no burn-outs*, for were it not for the double motor now so generally in use, we would see crippled cars being *towed* into the shop, greatly to our discomfiture. In the matter of minor details, such as cables, terminals, trolleys and gearing, the electric manufacturers have made the greatest improvements during the past 18 months, but so far as we can obtain information, based on actual facts, there has been but little improvement in the armatures. The Edison Company has recently announced a new armature, but we have been unable to learn what results it may show.

The switch-box, such as used by the Edison-Sprague and Westinghouse, is an apparatus, that if given proper care, so as to keep the brass plates and buttons smooth, ought not to cause much trouble. It is arranged so as to distribute the current through different parts of the magnets or the motor, according to the degree of speed or work required. It is somewhat in the way of passengers when the platform is overcrowded. The rheostat used by the Thomson-Houston Company is out of the way, being underneath the platform, although it is burnt out occasionally and damaged by rain leaking through the platform; these defects should be easily overcome. It is claimed that owing to the use of the rheostat of the Thomson-Houston Company and the resistance coils as used by the Westinghouse Company, that the cars start much more easily and without jerking, and that the motor is less liable to burn out, as they avoid throwing in an excess of current. The first claim is true, but we cannot find evidence to support the latter claim. On the other hand, it has been claimed that motors using a rheostat require on an average run from 15 to 20 per cent. more power than the Edison-Sprague motor. It does not necessarily follow that this is due to the rheostat; it seems likely that it is due as much to a difference in the winding of armature or fields. It would be most desirable, therefore, to ascertain from our various members the actual number of burn-outs of fields and armatures, of both varieties of motors, and at the same time the average power used per car. This cannot be obtained by writing for reports, as many roads do not keep an exact record, or will not report the same. The grades of roads must be considered, the car mileage, and loads carried, also the system or manner with which motors are repaired and cared for.

This is a matter of the greatest importance. Our fuel costs about $1 per car per diem, and our repairs over $1.50 per car per diem. If we can save 10 per cent. each day by giving up the rheostat, we do not want to do it at the expense of adding 25 per cent. to our repair account which, we all know, is too large already. As an example of the approximate cost of repairs, I give the cost of four 30 horse-power Sprague cars for the six months ending October 1, 1890, each car making 90 miles a day, a grade 1,900 feet of 9 to 9¾ per cent., one 300 feet of 5 per cent., one 300 feet of 8 per cent.

Mechanical.

3 Bronze intermediate pinion, at $14		$42 00
3 Steel " " at $9.		27 00
8 Steel Armature " at $7.		56 00
4 Intermediate Gear, at $11.....		44 00
2 Main Gear (axle), at $16		32 00
6 Axle Brasses, at $4.50.....		27 00
8 Shaft Bearings, at $4.50.....		36 00
12 Armature Bearings, at $2.75.....		32 00
Total.....		$296 00

Electrical.

180 Carbon Brushes, at.. 10 cents.		$18 00
6 Trolley wheels, at..$1 25.....		7 50
3 Field Magnets, at..$20 00.....		60 00
6 Armatures repaired, at $35 00..		210 00
		$295 50

For Labor:

2 Motor repair men, at $50 00 per Month.....	600 00
Total...	$1,191 50

Average per diem, per car, $1.62

There are other minor repairs that would increase this about 20 cents a day. Fuel, sawdust and slabs, $1.30

This fuel is about equal to screening or slack at $1.50 a ton. A greater number of cars would reduce this fuel account per car. During the six months the expense on the overhead line was less than $25 on five miles of line.

We have learned of an eight-car road running at $1 per car for fuel, another six-car road at 90 cents per diem per car. We do not believe in any case that the fuel will equal the cost of motor repairs. The first year of operation must not be taken as a fair estimate. The prices for gear and bearings will vary considerably from those given above. Some axle brasses cost $9, while those above are given at $4.50. Aluminum or some such compound may be mixed and used to decrease the cost and increase the durability of bearings. It was sold a few years ago at $3 and upwards per pound, now at $1, and, it is stated, can be produced for 20 cents per pound.

In the matter of gear the Westinghouse Company has so boxed the same that it can run in oil and grease; this must undoubtedly add much to the life of the gear and pinion, and at the same time practically deaden the noise. Whether this boxing will stand the wear and jar, time will best demonstrate.

The following report of a road operating

(*Continued on page 110.*)

The Writing Telegraph.

"An instrument which will permit us to write at a distance is a valuable addition to telegraphy."

The illustrations accompanying this article show the apparatus used by the Writing Telegraph Company, of this city, in their system, which consists in transmitting from one station, and receiving at another, the compound movement of a point in two directions, one at an angle to the other.

The company operates under the patents granted to Mr. Edward Alfred Cowper, of England, the deviser of writing telegraphy, Mr. J. Hart Robertson and Mr. Harry Etheridge, all of these patents being owned by the company.

The working parts of the instrument are placed in a case, as shown in Fig. 1. This

FIG. 1.—THE WRITING TELEGRAPH INSTRUMENT, OPEN.

FIG. 2.—INSTRUMENTCL

case is about 12 inches long, 10 inches wide and 8 inches deep. On top of the case appears the paper, the receiving pen for recording the message and the handle of the transmitting stylus for writing. In Fig. 2 the instrument is shown closed. A message may be received with the case open or shut,

FIG. 3.—LIBRARY DESK, OPEN.

the presence of an attendant being unnecessary.

When the instrument is to be used in private residences or offices, it is mounted in a handsome desk. The library style of desk is shown in Fig. 3. Some specimens of the work done by the instrument are shown in Fig. 4.

The manner of writing is as follows: The person desiring to write takes hold of the stylus rod and watching the recording pen, makes it form what letters he wishes, and the receiving pen of the distant instrument also makes a *fac-simile* of every letter or mark. The pen follows every movement of the stylus rod, stopping where it stops and moving when and where it moves. If the stylus is moved to the right, the pen moves to the right. If the stylus is given a downward pull, the pen makes a downward stroke. If a curve, the pen makes the curve. It is said to take but a few minutes to get used to the moving paper and to form the letters without moving the hand to the right. That is all there is to learn to operate the instrument.

It is soon found that pulling the pen electrically, by means of the stylus, is a very easy way to write, and many claim it is easier than writing directly on paper with an ordinary pen. It has its advantages, too, in the simplicity of the instrument when thus constructed. The characteristics of the handwriting of the operator all appear.

The instruments have been in use for some time by several of the Pittsburgh daily papers and they have expressed their satisfaction by sending the Writing Telegraph Company very strong testimonials in their favor. A large number of instruments are in service in different parts of the country, and their reliability and usefulness has been proven by the test of time. It is certainly an ingenious and most useful device.

The Writing Telegraph Company is capitalized at $500,000 and is governed by the following officers: Brent Good, president; S. R. Pinckney, vice-president; and W. E. Gump, general manager. The offices of the company are at 57 Murray street, New York city.

The enterprising telephone people are endeavoring to show the naval authorities the advantage of its system for communication on board ship. The company has installed at its own expense telephonic apparatus on board the cruiser "Philadelphia," which, if successful, will, it is hoped, induce the authorities to equip the remaining vessels of the new navy in like manner.

Brooklyn Institute.

A special meeting of the department of electricity of the Brooklyn Institute, was held at the Young Men's Christian Association, on the afternoon of October 10th, for the election of officers and the completion of arrangements for the first exhibit of the department. The officers elected for the coming year were: James Hamblet, president; Prof. Samuel Sheldon, first vice-president; J. P. Wintringham, second vice-president; William H. Randall, secretary; and R. N. Baylis, treasurer. It was decided to have the exhibit of the department October 31st, in the large hall of the Union for Christian Work, 67 Schermerhorn street. The exhibition is for batteries alone, and will include not only batteries in working order, but parts of batteries and appliances used in the manufacture of them. Each member of the department is to be informed that should he desire to make an exhibit of apparatus of the kind described, he will be given the requisite space in the hall by notifying the chairman of the committee on the exhibit of electric batteries what exhibit he proposes to make and what table space he will require, at least three days preceding the date of the exhibit. The committee on exhibit are: James Hamblet, chairman; William D. Sargent, J. C. Reilly, Charles F. Chichester, R. J. Murphy, O. R. Robertson, Charles H. Matchett, Lewis Moore, George W. Hunt, N. B. Nearing, J. C. F. Priest and J. F. Moody.

.... The Western Union Telegraph Company held its annual meeting at New York, October 8th, and elected Charles F. Mayer, president of the Baltimore and Ohio Railroad, a director to fill the vacancy caused by the death of John Jacob Astor. The annual report showed an increase in gross earnings of $1,603,834 and of $1,094,683 in net profits. The additions to the plant in the year were 5,163 miles of line and cables, 31,300 miles of wire and 912 offices. The cost was $1,778,314, but this included two new ocean cables from New York to Canso, N. S. The company now has 678,997 miles of wire, 19,382 offices, and last year it handled 55,878,762 messages.

... The second annual ball of the New York Telegraphers' Club was held at the Central Opera House, in Sixty-seventh street, on the evening of October 15th. An episode which added to the general enjoyment of the evening was the presentation of the prize given by the Hon. James D. Reid, United States Consul at Dunfermline, Scotland, to Miss Kittie Stephenson, the winner of the first prize in the ladies' class in the fast-sending tournament held in this city, at Hardman Hall, last April.

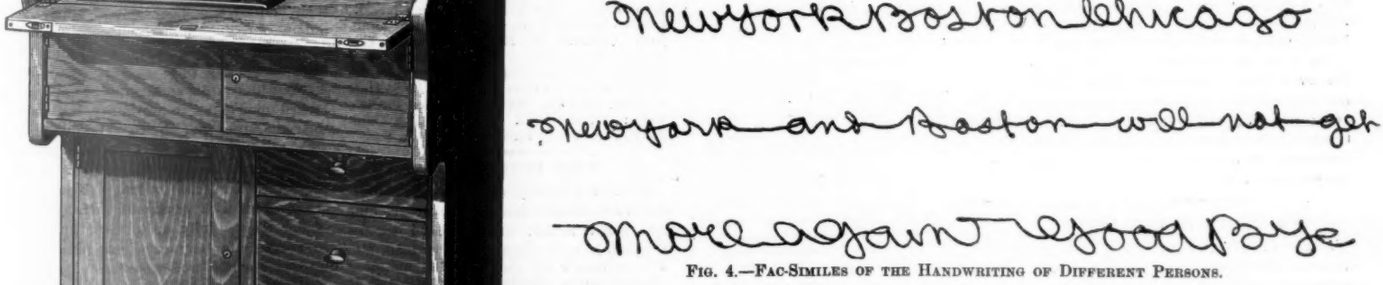


FIG. 4.—FAC-SIMILES OF THE HANDWRITING OF DIFFERENT PERSONS.

TELEGRAPHIC

.... China has 136 telegraph stations. The system is mainly controlled by the government, and the operators are all Danes.

.... A resolution was adopted at Memphis, Tenn., recently, requiring telegraph and telephone poles to be not less than 60 feet in height.

.... The Erie Railroad Company will soon commence the work of erecting tower telegraph offices on all the sidings between stations, which are called "blind sidings."

.... The Postal-Telegraph Company is expanding and improving their system very rapidly these days. Four new copper wires are being stretched between Cincinnati and Columbus, Ohio.

.... The annual meeting of the directors of the Commercial Union Telegraph Company took place at Albany, N. Y., October 8th. A dividend of five per cent. was declared and the old board of directors elected, as follows: Henry Russell, Henry L. Smith, E. J. Slattery, Chas. E. Arnold, Albany; and A. B. Chandler, New York.

.... The international telegraphic rates on the continent will conform, after July 1st next, with the schedule fixed by the recent international telegraphic conference in Paris. Between Germany and adjoining countries the rate will be 2½ cents per word; between Germany and Great Britain, Scandinavia or Italy, 3½ cents per word, and between Germany and Russia, Spain or the Balkan, five cents per word.

.... The steamer "Silvertown," belonging to the India Rubber, Gutta-Percha and Telegraph Works Company, Limited, of London, having on board 1,750 miles of cable for the Central and South American Telegraph Company, of New York, passed Dover at 5 P. M., October 11th, *en route* for Valparaiso. This cable is to be laid between Chorillos, Peru, and Valparaiso, Chili, touching at Iquique, as an extension of the American line *via* Galveston.

Canadian Telegraph Decision.

In the case of Tremblay *vs.* The Great North Western Telegraph Company of Canada, judgment was rendered last week, at Montreal, in favor of the telegraph company. The action arose from the defendant having cut down some small trees and the branches of some ornamental trees at Point aux Trembles which were in the way of the telegraph line. It was shown in evidence that it was absolutely necessary in order to the effective working of the line that the obstruction should be removed. Mr. Justice Caron held that the charter of the Montreal Telegraph Company, under which the Great North Western Telegraph Company were working, was explicit in giving them the power to remove all obstructions, provided they were necessary to the working of the line. This is a valuable decision for the company as there are many instances in which parties who have like claims will hesitate before taking action.

* * Harrisburgh, Pa., wants an electric railway.

* * The street car lines of Auburn, N. Y., are all to be run by electricity.

* * Twenty-six miles of electric railroad have been built and are in operation in Augusta.

* * Electric cars were run in New Bedford, Mass., for the first time on October 10. Thomson-Houston overhead system.

* * The Perrault Electric Lighting Company has offered to run the elevator in the City Hall at Montreal for $50 per month, if the city will make connections with their station, at a cost of $2,000.

* * The Jordan Trolley Supporter is used on the West End Railway, in Boston, with marked success, and since the Central Electric Company put it on the market in the West, it has met with much favor.

* * Another electric railway line began operations at San Antonio, Tex., on October 7. It is the Laurel Heights Line. The cars worked very smoothly and successfully. Two more electric lines are in process of construction.

* * The directors of the Springfield, Mass., Street Railway Company have decided to double the capital stock, making it $400,000, so as to cover the expense of introducing the electric system on all the lines within the city limits.

* * It is said that a naphtha motor which will be used on the street railway between Ann Arbor and Ypsilanti, Mich., is "better than electricity and 90 per cent. cheaper." Let's hear more about it—say, a comparative test with an electric motor.

* * The Belding Motor and Manufacturing Company will build a new plant at Chicago. Three 125 horse-power boilers and two 100 horse-power engines will be installed. The machinery will be arranged in groups and operated by electric motors, a separate dynamo furnishing current for each group. This will be the first factory in Chicago in which electric motors will run all the machinery.

* * The Accumulator Company, of this city, has just closed a contract with the Dubuque Street Railway Company, of Dubuque, Iowa, for six Edco cars, operated by "The Accumulator System." This contract was made after President Rhomberg, of the Dubuque Street Railway Company, had made an exhaustive test of the system for three months. It is the intention of Mr. Rhomberg to equip his whole road with Accumulator cars.

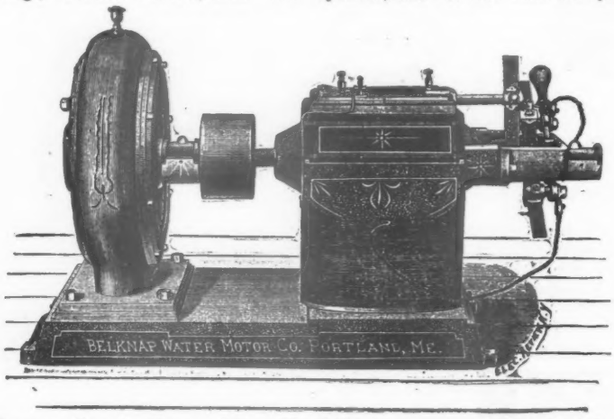
New Electric Railway Work.

During the past two months the Thomson-Houston Electric Company has been actively engaged in completing the construction and have put in operation electric railways at Concord, N. H.; Shreveport, La.; Newark N. J.; St. Paul, Minn.; Memphis, Tenn.; Anaconda, Mont.; Helena, Mont. These roads comprise 50 motor cars, and 33.54 miles of track. The St. Paul road was put in operation on October 6th, 1890, and has been running satisfactorily ever since. The Concord Horse Railroad, Concord, N. H., eight cars and seven miles of track, was started October 8th, the trial car having on board the officials of the road and invited guests. Everything in the working of the system was excellent, and the best of results are anticipated by the officials of the road. The road of the Shreveport Land and Improvement Company, Shreveport, La., four cars and 5.25 miles of track, was put in operation October 4th, and opens up for residence a large territory owned by the Shreveport Land Company. The initial run was made without an accident of any kind, every car being utilized and working to the entire satisfaction of all present. The City and Suburban Railway, Memphis, Tenn., five cars and five miles of track, was formally opened at 5 A. M., on October 6th, 1890, in the presence of about 500 people. The cars all worked well and their operation on daily schedule time since the time of starting has convinced the residents of Memphis that the benefits of rapid transit have in no sense been exaggerated. On October 4th, the city of Newark turned its back on horse car traction and inaugurated a new system which is working to the entire satisfaction of those interested in the road and the public as well. The company has equipped 5.75 miles of track, and have 20 cars in operation. The people are very enthusiastic over the new method of transit.

Strikes in the Electrical Industry.

A volume of great statistical value has just been issued by the State of New York. It emanates from the Bureau of Statistics of Labor, and is a *resumé* of the strikes occurring in New York State during the five years from 1885 to 1889. It is a volume of 822 pages, and contains the particulars of one or more strikes in almost every trade and profession. It is most gratifying to note that the only reference to labor troubles in the electrical field is made under the two headings, "Electric Housewiremen" and "Messenger Boys." The particulars of these strikes follow:

Trade or Industry.	Years.	No. of Establishments Reported on Strike.	No. Successful.	No. Compromised or Partly Successful.	No. Unsuccessful.	No. of Persons Engaged in Strike.	No. of Persons Refused Work After Strike.	Amount Lost in Wages.	Amount Expended for Relief and Conduct of Strike.	Estimated Gain in Wages.	Loss to Employés from all Causes.
Electric housewiremen	1889	1	1			25					
Wiremen (electric)	1886										
Totals	....	15	1	2	12	310	67	$91 75	....	....	$822 50
Messenger boys	1885	1		1		25	15	$40 00			
"	1886	1			1	70	10	35 00			
"	1887	3		1	2	90		2 50			
"	1888	9	1		9	25			$25 00		
Totals		14	1	1	12	210	25	$77 50	$25 00	....	$822 50
Grand totals		29	2	3	24	520	92	$169 25	$25 00	....	$1,644 50



Electrical Exhibits at the Mechanics' Fair, Boston, Mass.

Three weeks have nearly passed away since the Seventeenth Triennial Fair of the Mechanics' Charitable Association was thrown open to the public, and as yet less than half the proposed exhibits are in position. Very few of the electrical displays at this writing are in presentable shape, yet progress is being rapidly made in the right direction to bring the electrical exhibition of this year up to a higher standard, and which will probably be more attractive than that of any previous fair.

Those who have already engaged space for the display of electrical goods, apparatus, machinery, etc., are: Albert L. Russell, Boston, electrical and scientific instruments; Holtzer-Cabot Electric Company, Boston, electrical goods; Mr. E. H. Rowe, Boston, electric safety device; New England Phonograph Company, Boston, phonographs and graphophones; Electric Machine Company, Boston, electric time stamp; Isolated Department Thomson-Houston Company, incandescent machines; Mather Electric Company, Manchester, Conn., arc and incandescent machines; Belknap Motor Company, Portland, Me., small dynamos and water motors; Tripp Manufacturing Company, Boston, trucks for electric railways; Robinson Radial Car Truck Company, Boston; trucks for electric railways; Evans Friction Cone Company, Boston, system of driving dynamos; The "C. & C." Motor Company, of New York, motors; Interior Conduit and Insulation Company, New York, display board of pipes, joints, etc., for interior wiring and construction work; American Tool and Machine Company, Boston, patent dynamo belt controller; Westinghouse, Church & Kerr, Boston, the Roney mechanical stoker and patent steam loop; the Rodney Hunt Company, Orange, Mass., turbine water wheels; Mason Regulator Co., Boston, damper regulators; Chas. A. Schieren & Company, New York, belting; Chas. L. Ireson, Boston, belting; Page Belting Company, Concord, N. H., belting; Otto Gas Engine Company, Philadelphia, engines; Wheeler Reflector Company, Boston, shades and reflectors for electric lights; B. S. Hale & Sons, Malden, Mass., insulated electric wires; and the Park Manufacturing Company, Boston, the Park injector.

Water Power Dynamo.

In the accompanying engraving is illustrated a combined dynamo-electric machine and water motor, manufactured by the Belknap Motor Company, of Portland, Me. The armature of the motor is mounted upon the same spindle as the rotary part of a turbine water motor. The armature is wound with two circuits, one discharging through continuous collector rings into a lighting or power circuit and delivering alternating currents, and the other being connected through a two-part commutator for exciting magnetism in the field magnets and armature. The wearing parts of the commutator are made of phosphor-bronze, and may be detached by loosening a single screw, so as to replace them when badly worn. The buckets of the turbine wheel run very close to the water chute, and the full force of the water is exerted on the wheel at a point nearer the orifice than is the case in motors generally. The armature consists of an iron core square in cross section and mounted on a steel shaft, and is wound so as to fill out the space between the square prism and the cylinder. The bearings for the shaft are provided with self-oiling boxes. The machine is made in three sizes, so as to supply a circuit containing 10, 20 or 30 lights, and the motors are said to be capable of maintaining these lights at full candle-power under a water pressure of 65 pounds.

The Central Electric Company have furnished the Davenport Street Railway Company with their entire supply equipment, consisting of 110,000 pounds of copper wire, and 50,000 pounds of improved Candee wire. Candee wire has had quite a success in railway work, and it has proved equal to the severity of the tests placed upon it.

The Fibrone Manufacturing Company, 35 Warren street, New York, are now in a position to turn out orders promptly for articles used in street railway construction made of their new material, "Fibroid." This new material is said to be not only fire, water and acid proof, but indestructible. It has been highly endorsed by some of the leading electrical houses in this city. Their other materials, "Fibrone" and "Plasticon," are also receiving considerable attention.

Cleveland, Ohio.—The increase in business of the Fletcher & Fletcher Electric Company, Cleveland, Ohio, has necessitated additions to their works, which now extend from South Water street through to the "Big Four" railway tracks in their rear. Their low prices on annunciators, bells, pushes, switches, etc., has won for them a large trade among progressive bellhangers in every State and Canada. They ask all to write for price lists with discounts, inclosing a business card.

The Thomson-Houston Electric Company, through the Western Isolated Light Department, Chicago, has sold a plant to Shailer & Schniglan, of Chicago, for the Lake View water works, tunnel and crib, which will be unique in some respects. The dynamo will not only supply current for the electric lights at the water works on shore, but will also be used to run a motor at the crib for ringing a fog bell. The same dynamo will also supply current for a number of incandescent lamps in the lighthouse on the crib, taking the place of the ordinary lighthouse oil lamps.

The Eureka Tempered Copper Company, of North East, Pa., moved into their new factory in February last, and have lately been compelled to double the size of their plant and the number of their employés. They report nearly 200 orders for their goods in September. Their peculiar process, by which they furnish chemically pure copper, cast solid, without blow holes and tempered hard, was looked upon as an impossibility, but under their guarantee that their goods should be without alloy and wear three times as long as drop forged copper for electrical work, they received trial orders. Now they are crowded with work, and their metal is giving results fully up to their guarantee for commutator segments, gear pinions, armature bearings, trolleys, etc.

W. R. Fleming & Company, 174 Fulton street, New York, the selling agents for the "Ide" and "Ideal" engines, simple and compound, and other manufactures of the Foundry and Machine Department, Harrisburg, Pa., including steel return tubular boilers, report that they have just closed a very large contract for a complete steam plant to go to Mexico. This is the second order on account of the same electric company. Fleming & Company state that they are having a great run on their engines, particularly the "Ideal," which is a center crank, automatic, self-oiling engine. It is built very heavy for severe duty, and is in great favor with the electric street railway companies and electric light companies, because of its simplicity, wonderfully close regulation, and the little care it requires when running. All parts of the engine run in oil and are accessible while the engine is in operation, without the removal of a single bolt or screw. Their side crank "Ide" engine is having a very large sale.

Schuyler Electric Company.

The annual meeting of the stockholders of the Schuyler Electric Company was held at the office of the company at Middletown, Conn., on October 6th, nearly all of the stock being represented. The annual statement showed the business of the company to be in a prosperous condition, with a good outlook for the coming year. The company started in October, 1887, with 35 employés, and in three years has increased the number to 272. The following gentlemen were elected directors for the ensuing year: S. H. Butler, John N. Camp, Walter B. Hubbard and C. E. Jackson, of Middletown; C. N. Wayland and C. L. Buckingham, of New York; and Charles E. Dustin, of Hartford. A meeting of the directors was held immediately afterward, at which the following officers were elected: President, Charles E. Dustin; vice-president, S. H. Butler; treasurer, Joseph T. Elliott; and secretary, D. J. Glazier.

The Manufacture of Aluminum.

The usefulness of aluminum is becoming rapidly known, and yet its practical utility has only been very recently successfully demonstrated. Of course, the metal was known long ago, and its advantages were at once realized; but the great cost of its production prevented it from becoming a competitor of other metals.

That aluminum now bids fair to eclipse even iron and steel in many instances as a commercial commodity is mainly due to electricity. Owing to the fact that electricity has the faculty of separating pure aluminum from its surrounding impurities, and that it helps to reduce the expense of production, the metal has now become usefu in many ways.

There are, however, still but very few aluminum factories in the world, and among them the Pittsburgh Reduction Company is one of the largest.

Since the electric current plays a very important part in the manufacture of the metal, a visit was paid to the works a few days ago in order to get an idea as to the manner in which electricity is applied in the process of producing aluminum.

Aluminum exists in nature in the form of an oxide so refractory in its character as to make reduction in any ordinary furnace impossible. The only means which have been found available for its reduction on a commercial scale being by electrolysis, it is this method which has been perfected by the Pittsburgh Reduction Company.

The company's power plant consists of several Babcock & Wilcox boilers and the engines are three in number, two being of 200 horse-power of the Westinghouse compound type and one a Westinghouse automatic engine of 125 horse-power.

The electric plant consists of four direct current dynamos made by the Westinghouse Electric and Manufacturing Company and the U. S. Electric Lighting Company, of Newark, N. J. The armatures of these dynamos are shunt wound and all of them furnish the current for the reducing pots. Two of these dynamos are immense machines. They are wound to generate a current of 2,500 amperes at a pressure of 50 volts, running at a speed of 325 revolutions per minute. These two dynamos are probably the largest in the country, and they have been especially made for the work in this factory. The other two machines furnish a current of 1,000 amperes each.

The two larger dynamos are connected in parallel, as well as the two smaller ones, though on an independent and separate circuit. The arrangements for transmitting the 5,000 ampere current for the two large dynamos are striking and somewhat novel in the way of electric current conductors, two copper bars, each six inches by one-half inch, having a total area of cross section of six square inches, being used. For the 2,000 amperes current from the small dynamos, a similarly shaped bar, four inches by one-half inch is used. Fortunately, it is necessary to carry the current but a very short distance on such expensive conductors as these.

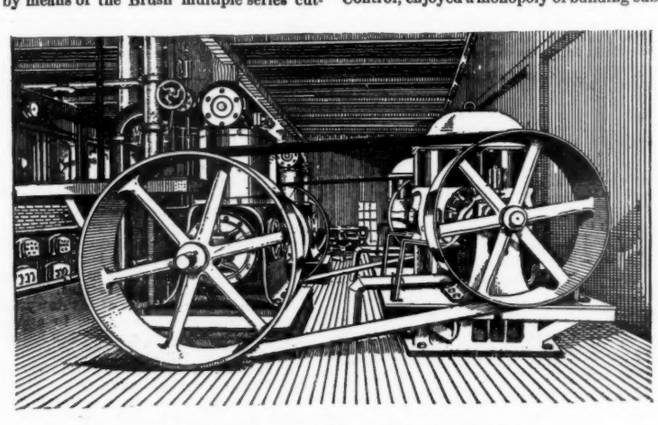
Since the works of the Pittsburgh Reduction Company have been operated, their production of this valuable metal has been constantly on the increase, and the demand is now so great that the company is contemplating an enlargement of its plant in order to make the producing capacity greater than it is at present. The Pittsburgh Company also operates a similar plant in Manchester, England.

Water Power and Electric Transmission.

The first practical demonstration of electric transmission of power for mining purposes in California, has been inaugurated by the American River Syndicate in El Dorado County—an English organization under the management of Mr. George Cullen Pearson. The power station is located on Rock Creek, some 1,500 feet below the mine and mill, and two miles distant in a straight line. The following is from the San Francisco *Mining Review*:

The plant consists of an 8-foot Pelton wheel, which, running under a head of 110 feet at 100 revolutions, with a 5⅛ inch nozzle, has a maximum capacity of 130 horse-power. To this wheel is connected a 100 horse-power Brush generator, speeded at 900 revolutions, the current from which is carried to the mill through a single insulated copper wire, No. 3 B. & S. gauge, the return being made by a wire of the same size, making a four-mile circuit. The power from the generator is communicated to the countershaft of the mill by a 70 horse-power Brush motor running at 950 revolutions.

The machinery operated consists of three centrifugal roller mills, a ten-stamp battery and a rock breaker. The Pelton wheel, under these conditions, shows an efficiency of 86 per cent., while 85 per cent. of the power thus generated is available for duty at the mill, though only 70 per cent. was called for in the contract with the Brush Company. Sufficient power is taken from the main circuit to run 60 incandescent lamps for lighting the works, the current being cut in by means of the Brush multiple series cut-out box, which admits of incandescent lights being operated by a high-tension current.



Electric Plant Used in Manufacture of Aluminum

The company owning their own water right, the operating expenses of this plant are almost nominal; only one attendant is required at the power station, and this not an electrical expert, but one of the company's employés. If the distance between the generating station and the mill were five or ten miles, instead of two, it would simply have been a question of a larger expenditure for wire with a somewhat smaller percentage of power delivered.

This equipment has now been in constant operation for five months, and is a most pronounced success, no interruption to the service at any moment having occurred during this time. The mills named are handling an average of 4,000 tons of ore per month, effecting a saving of some 60 per cent. over the former method of working by steam power, estimating wood at $3.50 per cord, while the cost of maintenance is about six to one in favor of electricity.

Facts like these are as potential as the power upon which they are based, and go far to dispel the idea, still so prevalent, that electricity is an unreliable, dangerous and uncontrollable force. While this is at present the only installation of the kind in California, several extensive plants of similar character are now running in Colorado, with results equally satisfactory, and it is believed that this system, embracing, as it does, as great a degree of reliability as steam, with much greater economy, will soon come into very general use where the conditions do not admit of a direct application of power to the machinery to be run.

How to Obtain a Spark.

A very simple apparatus for obtaining an electric spark is made by a German physicist. Around the center of a common lamp chimney is pasted a strip of tinfoil, and another strip from one end of the chimney to within a quarter of an inch of this ring. Then a piece of silk is wrapped around a brush, and the interior is rubbed briskly. In the dark a bright electric spark may be seen to pass from one piece of tinfoil to the other each time the brush is withdrawn from the chimney. Many other experiments can be tried with this apparatus.

Rentals Too High.

FIGHT BETWEEN THE ELECTRIC LIGHT COMPANIES AND THE SUBWAY COMPANY, NEW YORK.

Last week suits were commenced against the Consolidated Telegraph and Electrical Subway Company by the United Electric Light and Power Company, the United States Illuminating Company and the Brush Electric Illuminating Company, the Harlem Electric Lighting Company and the Manhattan Electric Light Company. It is expected that the other electric lighting companies will begin similar suits. The suits are instituted to determine the amount of rental which the Subway Company has a right to charge, and also to restrain the Subway Company from interfering with the cables and other property of the lighting companies in the subways. Judge Barrett, on Wednesday, granted temporary injunctions restraining the Subway Company from interfering with the cables. These injunctions were served upon the officers of the Subway Company, and the motion to make them permanent comes up for argument this week. Joseph H. Choate is one of the lawyers retained by the electric lighting companies. The electric light companies allege this state of facts:

The Consolidated Telegraph and Electrical Subway Company has heretofore, by virtue of its contract with the Board of Electrical Control, enjoyed a monopoly of building subways. Of the $3,000,000 of stock of this company, $1,605,000 is owned by the Metropolitan Telephone and Telegraph Company, $600,000 by the Edison Electric Illuminating Company, 4,380 shares by Edward Lauterbach, 2,500 shares by the North American Underground Construction Company, and the remaining shares by miscellaneous holders. It was stated by Mr. Lauterbach, at a recent meeting of the Board of Electrical Control, that bonds had been placed upon the subways to the amount of $4,750,000.

Mr. Paul D. Cravath, of counsel for three of the companies, speaks as follows concerning the matter:

"The position of the United States and Brush Companies and the United Electric Light and Power Company is exceedingly simple. The use of the subways is absolutely essential to our business, and we have been occupying them to the fullest possible extent in good faith. We have always been willing to pay the Subway Company a fair rental; we think the rentals sought to be charged are too high. We do not think it possible to decide intelligently what the rentals should be until the cost of the subways has been determined. We are not willing to accept the very meagre statements on this point furnished by the Subway Company. Many weeks ago we asked the Board of Electrical Control to investigate the cost of subways themselves, but it has not been done as yet. The demand of the Subway Company against us for rentals and other bills up to October 1st of this year, is about $170,000. Our payments to them amount to more than $130,000, and we feel that we have already paid them more than they are entitled to, and we do not propose to pay anything more until a fair rental has been fixed upon. We were forced to obtain an injunction at this particular time by reason of the threats of the Subway Company to interfere with our cables in the subways unless we acceded to their illegal demands, a part of which is that we shall not only satisfy their demands for rental prior to October 1, 1890, but to pay them rentals at the rate of $1,000 per mile per duct in advance for the whole year ending October 1, 1891. If they succeeded in these demands, they would collect for two years' rental about the amount which, in our opinion, the ducts cost."

ELECTRIC LIGHT NEWS

—— Mr. H. C. Sloan, of Lakeland, Fla., will soon commence the erection of an electric light plant in that place.

—— Yankton has been trying to get along without electric lights, and now the council has been petitioned to have the service restored.

—— An incandescent electric lamp has been burning in the boiler room of an electric light station at Jamestown, N. D., since May, 1888.

—— An explosion of accumulated gas in a subway manhole at Twenty-third street and Ninth avenue, caused a little ripple of excitement on the evening of October 16th.

—— Kingston, Can., has been recommended as the site for a branch of the Fort Wayne, Ind., Electric Company, to be established in Canada. Some 200 men will be employed.

—— The Thomson-Houston Lighting Company's Fifty-third street station, Chicago, is about ready for operation. The plant has a capacity of 2,300 incandescent and 50 arc lights. Ten miles of line wires have been placed in position.

—— On August 2d, 1890, the Thomson-Houston Electric Company commenced the equipment of the Alamo Street Railway, San Antonio, Texas, and on September 25th, 1890, in less than two months, had laid 10 miles of track, put up the overhead construction, and had 10 cars in operation, to the entire satisfaction of all parties concerned.

—— Judge Acheson, of the United States Court, at Pittsburgh, has made the formal decree dismissing the bill in the case of the Consolidated Electric Light Company against the McKeesport Light Company, which was decided against the plaintiff a year ago. The suit was a contest between the Westinghouse and Edison companies over a patent in regard to incandescent lamps, Edison winning.

—— Among the contracts for alternate current electric lighting apparatus which the Westinghouse Electric and Manufacturing Company obtained during the last week is one from the Elmira Illuminating Company, of Elmira, N. Y. This company was organized only a little over a year ago, with a view of supplying the citizens of Elmira with light. The plant erected was furnished with an apparatus of 750 lights capacity. The demand for the modern system of illumination, however; increased to such an extent that the Elmira Company was obliged to arrange for several additional alternating current machines. Three times an increase had to be made in the capacity, until the central station has generating machinery for a capacity of 3,750 alternating current incandescent lamps, the last contract being for 1,500 lights.

—— Electric lights have been in operation in Tampa, Fla., since 1887, and since then the Florida Electric Company, of that city, has energetically gone to work to prove to its patrons the many advantages accruing from the use of electric illumination. Operating the Westinghouse alternate current system of incandescent lighting, it was gratifying to know that a few days ago, the company contracted for additional apparatus which will enable the Tampa central station plant to generate sufficient electricity for furnishing the city with 1,900 sixteen candle-power incandescent lamps. Apart from these increases in the generating capacity which the Westinghouse Electric and Manufacturing Company has contracted to furnish, the alternate current system is also being introduced in new central stations at Durango, Cal., a plant with 750 lights capacity, and at Orange, N. J., the Westinghouse Company is also going to install a plant with its apparatus for 750 lights.

STREET RAILWAY CONVENTION.

(*Continued from page 106.*)

Thomson-Houston motors is most valuable in showing the proportion of cars disabled from electrical and mechanical causes, during 14 consecutive days in July, 1890:

Equipped.	Operated.	Disabled. Electrically.	Disabled. Mechanically.
286	150 to 200	0	15
286	150 to 200	0	12
286	150 to 200	2	12
286	150 to 200	5	8
286	150 to 200	0	11
286	150 to 200	3	11
286	150 to 200	3	9
286	150 to 200	1	10
286	150 to 200	5	7
286	150 to 200	2	11
286	150 to 200	2	15
286	150 to 200	2	13
286	150 to 200	1	12
286	150 to 200	0	12
		26	158

In seven consecutive days in August:

Equipped.	Operated.	Disabled. Electrically.	Disabled. Mechanically.
308	150	3	10
308	150	5	11
308	150	0	9
308	150	4	7
308	150	0	5
308	150	4	5
308	150	1	8
		17	55

During seven consecutive days in September:

Equipped.	Operated.	Disabled. Electrically.	Disabled. Mechanically.
312	150	2	3
312	150	5	3
312	150	3	2
312	150	3	3
312	150	0	5
312	150	1	4
312	150	1	4
		15	24

From this it appears that in July about one per cent. of cars operated were disabled each day from electrical causes, and about six per cent. from mechanical causes, and this during a period of extraordinary heavy business.

During the August period, the electrical trouble appears to have increased slightly in excess of one per cent. and the mechanical decreased to about five per cent., and in September the mechanical trouble decreased to about two per cent. This decrease was probably due, in some degree, to a lighter business and less mileage. As the report does not state the nature or degree of the electrical disabilities, it is not fair to assume that they were all due to crippled armatures, but we can deduce from it that a car ought to run 100 days without electric repairs.

The Convention then adjourned until 7.30 P. M., and devoted the afternoon to visiting the Westinghouse exhibit of their new motor on the new Pullman car at Cold Springs, the Thomson-Houston sweeper, the Edco car, and to seeing the various other exhibits in the Arcade.

EXECUTIVE SESSION.

After reading the above report, the Association adjourned to meet in the evening in executive session. It is understood that at the meeting in the evening there was some discussion involving the cost of operation and repairs of electric railroads; but by request of the speakers, the matter was not given for publication. The general testimony, however, did not vary much from the figures as given in the report above.

THURSDAY'S SESSION.

Mr. George W. Mansfield, representing the Attleboro Electric Road, addressed the meeting as follows:

I came here like many others to listen and learn. I am a director in the road, and take a deep interest in its operation; but I cannot give you any specific and accurate figures in regard to the cost of operating the road, either for power or repairs to the motor. We hire our power, and are in one of those unpleasant predicaments that no doubt many other electric railroad men have found themselves in when they came to pay another concern for the power supplied to their car. Some of these companies want from three to five dollars per day for the first three or four cars, and perhaps fall off 50 cents per car thereafter. I have even heard that one company wanted eight cents per car mile. I doubt not that in the East, and in a great many other places, they are paying in the neighborhood of from four to seven dollars on small roads of from four to seven cars, the cars making in the neighborhood of 100 to 120 miles a day. I do not know but that in some cases the electric light companies are warranted in making such a charge. They may have to pay four dollars and a half or five dollars a ton for coal; and I know that electric railway managers get all they can out of their electric cars. When an electric car has to climb a grade of eight or nine per cent. with perhaps 90 or 100 passengers on it, there is a pretty severe strain on the steam engine; and, perhaps, at the time it gets up or half way, some thing necessitates the current being cut off and the brakes applied and then the car starts again under these conditions. The indication of the steam engine on one car under these conditions has run as high as 71 or 72 horse-power. In Albany, on the Capitol Hill, they stop half way up the grade, about an eight per cent., and they have very heavy traffic, too. In a general way it has been my experience that the cost of operating an electric car per mile and the mileage being in the neighborhood of 110 miles, not to exceed 120 or fall below 90, perhaps, I make that provision since I know of some roads running as high as 160 miles, which is an excessive duty to impose on the car, but if the manager of the car permits it, and he has to pay 10 cents per mile on repairs, it is nothing more than he ought to do; I say, in the neighborhood of 110 miles, and under average conditions, perhaps grades of five per cent. I think that in a great many cases under these conditions, counting simply the maintenance expenses, meaning the oiler, wipers or cleaners, grease, repairs to all of the electric apparatus on the cars, including even the truck and not including any fixed charges or any thing of that kind at all, the cost of operation can be reduced to the neighborhood, on large roads, of about three cents per car mile. On small roads it costs more; perhaps four or four and a half. The whole matter is very largely a question of brains on the part of the managers of electric roads; and, so far as my observation goes, there is somewhat of a want in that direction. By brains I mean an intelligent mechanical inspection of the car and maintenance of the electrical apparatus. On this account, largely, it is difficult for any man to give, at this time, any accurate figures in regard to both the operating expenses and repairs of cars and at the station that would be applicable to all roads.

Mr. R. J. McCarty, superintendent of the Metropolitan Street Railway Co., of Kansas City, read a paper and spoke at considerable length on the comparative cost of operation of horse, electric and cable roads. His statistics showed that the cost of operation of a ten car road would be the same by electricity or horses; that when the number of cars was above ten the road could be operated more economically by electricity, and that when the number reached 50 cars and upward, he considered the cable to be the most reliable and economical.

The meeting on Thursday morning was, on motion, open to all interested, and a special committee was appointed to apprize the representatives of the different electrical systems that an opportunity would be afforded them to address the meeting.

After the reading of the regular papers on Thursday morning, Mr. D. H. Bates, vice-president of the Accumulator Company, took the floor, and after thanking the Association for the opportunity given him for presenting the subject, read the following paper on Storage Battery Street Cars:

THE EDCO STORAGE BATTERY STREET CAR.

The horse is a noble and extremely useful animal, but he seldom combines high speed with great endurance. The fast trotter is made to run his mile in from two and a quarter to three minutes, but he does it only on rare occasions and is well fed and cared for between times.

It was not until yesterday, when Mr. Odell's very interesting paper was read, that I had any idea of the innumerable obstacles to be surmounted in first securing a perfect street car horse, and, second, in maintaining him in a constantly efficient condition.

Judging from the expressions of a large number of street car men with whom I have talked on the subject of storage battery cars, I have inferred that your street car horse was ready for continuous hard work at all hours of the day or night. That it took no time to change horses at the end of a trip, and that you only fed them at night after a 60 mile run, and that oats and hay were always cheap.

For all these or like requirements must be met with in our storage batteries, if they are to satisfy the average street car official.

But when we undertake to show that the energy requisite to propel a 16-foot car with its average load of passengers at the horse car rate of speed must be increased 100 per cent. if the speed be doubled, and that the cost of producing that increased energy by whatever means you employ must necessarily be doubled, the scientific fact is, perhaps, admitted; but if storage batteries are the medium, it is always taken for granted that they ought to do double the service at half the cost.

The overhead systems in operation throughout the country have demonstrated to you, gentlemen, the fact that electricity is not the coming power, but the power already come. The mileage of street roads in the United States which in June, 1890, were operated electrically is, according to the Eleventh Census, $81\frac{36}{100}$ per cent. of the entire mileage; but omitting 59 cities, the proportion runs up to 25 per cent. This means one of two things, either that as a rule the authorities of our large cities will not allow overhead poles in the street, or that street car managers prefer to await the result from the use of the electric system on a small scale in the towns and smaller cities, before introducing it in the cities on a scale of greater magnitude.

The overhead systems already introduced in many places have so far improved upon the horse and mule that the public once given rapid transit would not go back to slower methods and are clamoring everywhere for such facilities.

You street car owners and representatives, however, must look at the resultant in the matter of cost per car mile and net profits, and before some of you yield to the loud demands of the public for rapid transit by adopting the overhead system, we beg of you to carefully consider the merits of the storage battery,

1. It will propel a car just as fast and just as efficiently with all that that implies as the trolley system. Every word that can be said in favor of the trolley system applies equally to the storage battery.

A storage battery car is capable of much work that a trolley car cannot accomplish.

a. Storage battery cars can be introduced gradually one or two at a time in connection with horse cars, cable cars or trolley cars.

We have already had proposals from a cable road for a few cars to be run at night when the cable could only run at a great proportionate expense, and from a trolley road where an extension was needed on a route that did not permit of trolley poles.

b. Storage battery cars can be run over any track or route where a horse car can be run. Thus avoiding blocks in cases of fires, processions and other obstructions.

Transfers of cars can, with this system, be made from one road or route to another in cases of necessity or convenience in handling an unusual traffic.

c. In cases of breakdown at power station during hours of heavy traffic, storage battery cars could run for two or three hours with the $33\frac{1}{3}$ per cent. reserve always remaining in the double sets of batteries.

Now, as to the figures relating to the battery system.

What is the cost of a storage battery car plant?

What does it cost per car mile to maintain?

What does it cost per car mile to operate?

Let us take a unit of 50 cars:

Fifty cars at $1,000—$50,000. Storage plant engine, nominally 500 horse-power (triple expansion), $12,500. Five hundred nominal horse-power boilers, 50 per cent. margin, $10,000. Fifty sets of car motor equipments, each consisting of two 15 horse-power slow speed motors, capable of being exerted up to 20 horse-power each for brief periods, with dust tight covers, gearing and motors running in oil, starting, regulating, reversing and speed, switches, lamps, signals, batteries, etc., complete, $249,400.

Central station equipment, including dynamos, rheostats, switches, reserve batteries, shifting appliances, etc., complete, $128,400.

Grand total, $450,300—say, $9,000 per car for every thing except buildings, roadbed and tracks.

Maintenance per annum.

Steam plant, 10 per cent.	$2,250
Cars, 10 per cent.	5,000
Electric plant, exclusive of batteries, 10 per cent.	21,500
Batteries, 20 per cent.	31,680
Shifting appliances, 5 per cent.	200
Total maintenance per annum	$60,630

Maintenance per car per annum, $1,212; maintenance per car day, $3.32; maintenance per car mile (on basis of 120 miles per day), $2\frac{3}{4}$ cents. With a smaller run the wear and tear would, of course, be reduced.

Data re Power Plant and Cost.—Horse-power required, 500; time required for producing such power, 18 hours; total horse-power hours, 9,000 hours; coal per horse-power with triple expansion engine, 2 pounds; coal per day, 18,000 pounds, or 9 short tons; coal being estimated at $3—$27.

Labor.—One chief engineer, $4; two assistants at $2.50, $5; two firemen at $2, $4; two assistants at $1.50, $3; six shifters at $1.50, $9; one electrician, $4; two assistants at $2.50, $5; one dynamo man, $3; total labor, $37.

Supplies.—Water per day, $5; oil and waste, $2.80; appurtenances and miscellaneous, $2.80; total supplies, $10.60.

Recapitulation and Summary.—Fuel per day, $27; labor per day, $37; supplies per day, $10.60; total cost per day for operation, $74; cost per car day for operation, $1.48; cost per car mile for operation, $1\frac{35}{100}$ cents; cost of maintenance per car mile, $2\frac{75}{100}$ cents; total cost of maintenance and operation per car mile, $3\frac{99}{100}$ cents.

The following are some of the conditions fulfilled by this company with its storage battery cars:

1st. That each car will be delivered in first-class order, with appliances for keeping it well under control, and for readily operating it with such skill as would be possessed by an intelligent car driver after suitable instruction.

2d. That each car will be run 15 miles an hour on a straight level, and suitable track, in good order, when carrying 50 passengers, or an equivalent weight, not exceeding 6,000 pounds.

3d. That each car with the above load will ascend grades not exceeding five per cent. and not longer than 500 feet, at the rate of at least five miles an hour.

4th. That two sets of batteries per car shall be delivered, either of which when fully charged shall be capable of propelling a loaded car as above on a straight level, and suitable track for a distance of 60 miles, if required, when it shall be replaced by the reserve battery, which, meanwhile, shall have been fully charged. Each battery can be charged while its alternate is being used. As a matter of policy, we advise retaining one-third of the charge of the battery as a reserve for emergencies.

5th. That the batteries, when treated according to printed instructions, and their parts renewed as required, will remain in an efficient condition,

We have already touched upon some points of advantage in the storage battery traction over the trolley system. We will now refer to the inherent defects of the trolley system, which do not pertain to storage traction.

1st. The disfigurement of streets by double lines of poles and trolley wires, with cobwebs at every curve.

2d. The frequent interruption of the entire system by a breakdown at the power station or in the feeder wires.

3d. The great and sudden fluctuations in the load which make such breakdowns of the power plant extremely frequent, many such breakdowns having already occured. With trolley and cable lines, the extremes of no load and full load are reached suddenly from one to a dozen times every five minutes. This is not only destructive to the machinery (steam, electric and cable), but frequently causes a breakdown of the whole line, involving heavy outlays for repairs, serious loss of revenue and dissatisfaction on the part of the public.

4th. Bad economy in the power station due to the fact that maximum power must be provided in the engines and dynamos instead of the average power as provided in the storage system, causing the engines with the trolley system to run with an average of about half their load and, therefore, uneconomically. With storage battery traction the engines and dynamos run with an even and unfluctuating load continuously, giving the best possible economy of coal and increasing the life of the plant.

5th. Economy and inconvenience of operation as compared with requiring an expenditure of energy in all portions of the line, even though but one or a few cars may be running. For suburban roads and all night runs this feature is of special importance.

6th. Liability of generators and motors being burned out by lightning passing through the bare trolley wires through the motors to the ground.

7th. Liability of motors burning out with the high voltage current.

8th. The business public is inconvenienced by the derangement of the telephone service due to induction and leakage from the trolley lines to such an extent as to make the telephone service useless and dangerous.

Last, and, perhaps, most important, at least, to the general public, the trolley system requires a current of high potential, conducted along bare wires extending over the entire route of the line, always liable to contact with electric light, telegraph, telephone, district messenger, fire alarm and police alarm wires, the system thus being a constant menace to life and property throughout the city. Contact with any foreign wire may lead to a conflagration such as destroyed immense values of property in Lynn and Boston within a year, and death to horses and human beings, numerous instances of both having been frequently reported in the public prints.

Therefore, we feel warranted in asking street car companies to give storage battery traction, which possess none of these disadvantages and involves none of these dangers, a fair trial under reasonable conditions and under the supervision of men experienced in the various branches of engineering involved in the business, and who have had nine years' experience in the manufacture and use of storage batteries.

Mr. Richardson, of Brooklyn: I under-

stood the gentlemen to say that the storage battery car could run 15 miles an hour for four hours, and that it takes as long to charge the battery as it does for the battery to work.

Mr. Bates: You are correct.

Mr. Richardson: There lies my great doubt as to its practicability in a road that wants to run 50 cars three minutes apart.

Mr. Bates: By a suitable provision of alternate batteries, that is accomplished easily. One of our cars has been in daily operation in Dubuque for 60 days, and we are now equipping the road with six cars.

Mr. Richardson: How long does it require to take out one set of batteries and substitute another?

Mr. Bates: It depends largely upon the skillfulness of the men employed; from one and a half to three minutes.

Mr. Richardson: What do you base your calculations upon as stated in your remarks; from actual figures that you have or by approximation?

Mr. Bates: From figures which we have very carefully prepared, and which are approximately correct, based upon 10,000 miles of service with our three cars.

Mr. McCarty, of Kansas City: How many horse-power per car is required?

Mr. Bates: It depends upon the number of motors we put out. Ten horse-power is about the amount of steam plant we require per car.

Mr. A. H. Chadbourne, of the Wenstrom Co., was the next speaker. He said: "Nearly every year there is brought to you something new in this line. This year we come before you with something that is a novelty. I think it is generally acknowledged that it is desirable to have a slow speed armature in a street car motor, and that the motor should be reduced in weight as much as possible, and, if possible, a device provided whereby the armature could be allowed to run free at all times without relation to the car speed. We accomplish these results in a very satisfactory way. We expected to have had a car in operation here, but owing to delays at our factory, have not been able to do so. We have a cast of our field magnets here. It is cast solid. The machine is 25 horse-power. The fields are cast in one solid piece of mitis metal. The speed of the armature is 400 revolutions a minute, developing 25 horse-power. The metal is cast in such a way that it has nearly the same properties of wrought iron, and has the advantage that it can be welded. The wires, instead of running over the periphery of the armature, run through it, and the external portion is turned down true, so that it presents a plain surface. The advantage of this is that it is impossible to have the wires spread or thrown apart. Another feature of the motor is the method of connecting the wires on the commutator. Sometimes there is a great deal of trouble with these connections by reason of the solder melting. We have no road in operation yet, but will have one in operation at Pottsville, Pa., by the first week in November. We also expect to have a motor in operation in Baltimore very shortly. Our construction is not unlike other companies in its detail, the overhead arrangement of wires being the same. You know what the trolleys are. The generator is unlike those with which you are familiar. It is a machine that works at slow speed. We also have a patent connection between the armature and the commutator. It runs at 425 revolutions per minute, developing 67½ horse-power, running perfectly cool. A peculiar feature is that their construction is such that they utilize to a greater extent than any other machine the magnetic qualities which are generated in it. Another point is the gearing. You are all familiar with the ordinary gearing. We have a gearing which we are prepared to put under any system. It is an inexpensive gearing to buy, and it is economical to operate. It is a gearing with wooden teeth and has a removable rim, which is absolutely noiseless; and we have reduced the point of wear to the cheapest part of the gear, the teeth. No matter how small the accident, if one of the teeth breaks, the gear is gone. There is no reason why our gear should ever break, and the wooden teeth will last anywhere from four to six months, in accordance with the work. In Atlantic City they ran all Summer long. The manager there stated that the gears had done excellent service. We use this gear on our system, and will put it on any other. Another point is, that owing to the slow speed, we do away with the intermediate countershaft, and, consequently, that does away with two bearings and two gears. We gear direct from the armature to the car axle. There is another feature worthy of your attention, and that is, the method by which we allow the armature to run at full speed at all times. The armature is started up and the gear runs freely; the rim revolves freely around the axle and is connected to it by a system of hydraulic gearing. It is by the operation of the oil in the gear that we get the difference of speed in the armature and car axle. The oil is forced up from one part to another and when the valve is open the rim will run free. If the valve is half way open, you will get a variation of speed.

Mr. Henry, of Pittsburgh: Do you propose in that machine to do away with the intermediate gearing entirely?

Mr. Chadbourne: Yes, sir.

Mr. Henry: In that way you get rid of one-half the machine under the car?

Mr. Chadbourne: Yes, sir. We do away with a large factor in repairs. It is the high speed of the street car motor that makes the trouble with the gearing. If your intermediate gear only ran 125 revolutions, it would be a very simple matter to keep the gears on. In a slow speed machine much of this trouble is overcome, and it is acknowledged to be a very desirable thing.

Mr. Malone Wheless, of the Wheless Electric Company, next addressed the meeting: We have a system in Washington that differs in no respect from the other systems, except that we carry our cars by an underground cable. It extends the whole length of the road, and feeds from the sections which are laid in the conduit and laid in the usual way. The sections of the conduit are carried along, and at every 300 feet, more or less, as occasion requires, switch-boxes are put in. This is about 16 inches square, and laid between the tracks in double tracks, or between the rail and slot rail for single track roads. The object of these switch-boxes is that when the car comes along they automatically connect the current in the cable with a given section. Suppose we have a mile of road, there is a mile of cable laid by the side of the track. From that cable, at every 300 feet, is laid a feeder that feeds one insulated section of conduit wire. The conduit wire is at all times dead—there is no current in it. The current at all times is in the cable, and when the car comes on to a section a device attached to the car acts in conjunction with the switch-box and the result is the connection is made from the cable to the wire in the conduit. The car instantly receives the current and passes over that section and on to the next, when the passage of the car off the section releases the armature in the switch-box, and, as a consequence, the section is cut out. The reason of "cutting in" is because putting a continuous conductor in a conduit has been found inexpedient, for two reasons. The first is the escape. I believe it is impossible to take a continuous conductor and transport it through five or six miles of conduit and not have such an escape, no matter how well insulated, that the efficiency of the motor is materially and seriously impaired when you get a long distance from the generator plant. The other reason is the liability to short-circuit. The advantages we found in cutting out wire in sections was that only a certain section was charged with current, and, consequently, a short-circuit could only occur at the point where the car was. This constitutes about what our underground system is; it is simple and does not exceed in cost the ordinary conduit, or very little more. Our overhead system is a duplicate of the main feature of our conduit system. We feed in sections. The overhead line is dead at all times, and there is no way in which a person can receive a shock from it. I shall be glad if gentlemen present would come to Washington and see our system.

The following remarks were made by Knight Neftel, of the United Electric Traction Company, of New York:

It is unnecessary for me to say anything regarding the value of storage battery traction, after the very apt remarks made by my friend of the Accumulator Company. I will simply give concisely our results in operating ten storage battery cars on the Madison Avenue Line in New York.

The equipment of each car consists of 108 Julien cells in 12 trays, nine cells in each, total weight 3,600 pounds. The motors in use until recently, and on the old cars now running, are of the Thomson-Houston type. We have now constructed a motor especially adapted to this class of work, and which is now being put on this line. An estimate of cost of operating has been submitted to you by another company, based on the performance of 50 cars. Our experience with ten cars in actual operation over an extended period, which, by the way, is the largest storage plant in this country, and next to the largest in the world, is as follows:

Generating plant, 8 horse-power per car. For ten cars 15 batteries are necessary. Rate at which each battery is charged, one and one-half hours for two hours discharge. One charge is adequate for a run of 40 miles on a level track. With the old cells and the old type of motor, these ten cars were operated at 10.6 cents per car mile; with the improved batteries and new type of motor, the life of the existing plants of the battery, at the present rate of disintegration, is at least three years. The negative plates, the other half of the battery, are as durable as the motor. It is generally conceded that the reason storage batteries have not been applied more extensively is the lack of confidence in the endurance of the batteries and litigation on patents.

We are prepared to demonstrate to you practically the life of the batteries, and the question of patents has been greatly cleared by the final decree giving Charles F. Brush, of Cleveland, a fundamental award of priority.

Our batteries are manufactured under the patents of Brush, Julien, Morris, Salome and others. We are now equipping a road in Indianapolis, Ind., on this system. Our company also furnishes overhead equipments, and we shall be pleased to have any member of the Convention visit the plant at Madison avenue and other roads equipped by us.

Mr. Graham, of Baltimore: Can you tell me the number of miles per day each car runs?

Mr. Neftel: Eighty.

Mr. Graham: The maximum grade?

Mr. Neftel: The maximum grade is about five and a half or six per cent.; there is a very severe grade for a short distance on one part of the road, between Seventy-second and Seventieth streets, going down.

Mr. Graham: What is the length of the grade?

Mr. Neftel: About two blocks.

Mr. Graham: Do you ever run on a grade higher than five and a half per cent.?

Mr. Neftel: Yes, sir; there is one grade which is seven and a half per cent. The motors will go up that, but, of course, it discharges the batteries very rapidly when you subject them to such heavy work.

Mr. Graham: Is the car capable of ascending any usual grade, say 10 per cent.?

Mr. Neftel: Yes, sir; it is simply a question of discharging the batteries.

Mr. Henry: When you say 10 cents per car mile, what is included?

Mr. Neftel: Everything, except the conductors and drivers. Of course, there is a reasonable amount for the repairs of the motors.

Mr. J. Potter, of the Short Electric Railway Company, next addressed the meeting. He said: The Brush Company, as you know, has been in the business of building dynamo machines and electric batteries for many years, being the pioneers among the pioneers of that business, in the world. We have been building dynamos since 1876. We have recognized that the electric street railway work is the severest to which the dynamo machine has ever been subjected; and in starting out in our electric work, we aimed, as no doubt all others have aimed, to build a dynamo machine that would stand the rough work with as few failures by stoppage as possible; and in the next place to make the delays incident to such stoppage as brief as possible, and the repair work simple and inexpensive as possible. We claim that with our motor we have reached a high point of perfection in these respects. The difference in our motor is mainly in the type of armature, where we use a ring instead of the usual drum type of armature. There are many advantages that we obtain by the use of this type of armature. The bobbins or sections of the armature are all independent, and in case of any burn-out or trouble, it would be confined to a single bobbin. Again, we get a very great diameter of armature, as compared with others, and are enabled to use larger pinions and save greatly in wear. As a matter of fact, since the beginning of the present year, we have never burnt out a field magnet or armature coil in actual service. This will be confirmed by any road operating our system. The favor it has met with, and the large number of orders we are taking, speak loudest in praise of the system. Another feature is the insulation of the motor entirely from the frame-work of the car and from the ground. We think this is a great advantage. We believe that a great deal of the expense and trouble is due to the grounding of the motor, the bursting through and burning out of armatures, fields and commutators. This insulation is carried to the gears. We make them with an insulated web to deaden sound, and use steel pinions and steel gears, steel axle gears, and overcome the noise at the same time.

Mr. W. J. Carruthers-Wain, president of the Tramways Institute of Great Britain and Ireland, was next called upon, and said: I came to this country with the hope of learning as much as I could about electric traction in America. What I want to know, and most people, is the item of depreciation and repairs; in other words, repairs and renewals, and the amount to be set aside as an annual sinking fund for the question of depreciation, which must inevitably ensue. It has struck me, not only in this assembly, but in many others, that figures, after all, are rather delusive. Electricity came under my observation this way. I was not satisfied, no man was satisfied with the system of tramway traction in Europe up to within the last three or four years. We had leased a line from the Birmingham authorities, with the proviso that it should be operated by cable; but there was not enough business to make that system profitable. Electricity appeared to be the only visible motive power; and in November, 1888, there was tried upon the Birmingham Central Tramways a self-contained electric motor, which was designed upon the Julien system by Mr. Thomas Parker, of the then Messrs. Elwell, Parker, Limited, and myself.

The directors of the Birmingham Central Tramways Company permitted the experiments to be conducted upon their lines upon condition that the electric motor to be used should be in the form of an engine, insisting that before they would consider the question of electricity at all in connection with their lines, they must be convinced by actual demonstration that the power was as great, if not in excess of their most powerful steam engines then in use; and when I point out that they are some 12 tons in weight, having cylinders nine inches in diameter, and carrying a pressure of 175 pounds to the square inch, you will agree it was no small task to attempt. However, upon actual trial the electric motor, although weighing only nine tons, when coupled to one of the steam engines, the electric engine hauled the steam engine in spite of the fact that steam was full on and pulling against the electric motor. We afterwards started and hauled with the electric car a load of some 30 tons up a grade of one in 32. We have also run with one charge of the accumulators 70 miles, hauling a car which, together with the load contained therein, weighed over six tons, and this on a very heavy grade of tramway traveling up a grade of one in 19, over 500 yards in length, during the day 10 times. This electric car has been so successfully run over their heaviest steam route, and given such satisfaction to the directors, that they gave an order for 12 electric cars, which have just completed what is undoubtedly the finest installation of its kind in the world.

The car is made to run upon a three foot six inch gauge, and is constructed to carry 50 passengers, 24 inside and 26 outside. It measures, over all, in length, 26 feet.

The foundation of the car is made of channel iron, strutted so as to give it great strength and rigidity. The car body is carried upon two bogeys of the ordinary kind, and the motor is geared to the axle of one bogey by a train of helical gearing. The accumulators are placed in trays, each tray containing eight cells, and these are carried under the seats of the car, the outer panels of which slide up behind the seats so as to admit of their being readily placed in position. The connections are so arranged that contact is made automatically as the trays are pushed into position. The whole forms four batteries. The switches are of the Julien type, and the car can be driven from either end. They are so constructed that the cells can be equalized and the batteries used either in parallel or series. The car, motor and batteries weigh nine tons, as against the steam engine and cars, 16½ tons, a large saving in dead load to be hauled. The work of charging the accumulators is reduced to a minimum by having a specially arranged balance lift or elevator. These work in pairs, one balancing the other. Each shelf is fitted with automatic connections, and is in every respect an exact duplicate of the car, so that when the accumulator trays are drawn thereon, automatic connection is made and the cells are charged whilst in position upon the ram without again being moved.

Mr. Richardson: How many cars are you running?

Mr. Wain: We have 12 altogether, but are only running five. I may say, as a point of interest, that during the time that line was under construction, we worked it first by a system of horse tramways, and the average takings were about $750 a week. During the time the electric road was in process of construction, the receipts on the horse line were reduced to $600 a week. Immediately the electric cars were put on, the takings jumped to $1,250 a week. This was not due to any additional service, because it is precisely the same; not to any increase in population, because it has not grown so rapidly, but simply to the fact that we have been able to put on in place of the wearisome horse car a comfortable car moving by electric power.

Mr. Henry: How often have you renewed the plates?

Mr. Wain: We have not renewed them at all. We expect to get a life out of our plates of six months. The question of profit on the workings of the storage battery is not a matter of speculation, but is a matter of dead certainty. Inasmuch as there are several gentlemen here connected with overhead systems, I should like to say I believe there is room for all—certainly in America, if not in England.

Mr. Henry: Do you reconstruct the horse track for the electric road?

Mr. Wain: It was reconstructed; but not solely for that reason. The road was very much dilapidated.

Mr. Henry: What percentage of loss in efficiency in the motor is there?

Mr. Wain: I am not going to give you that, because three months' work is not sufficient time in which to give a general test. I

understand as nearly as possible we get 50 per cent. on the wheels.

Mr. E. E. Higgins, of the Edison-Sprague Company, next took the floor, and said: The Edison Company, with its accustomed modesty, desires to say that it has the best electric system in the world. The reason is two-fold. In the first place, as you are no doubt aware, it is acknowledged that the Edison motor will consume less coal. This is an important point and has bearings in many directions. If we can operate 100 cars with 750 horse-power as an average output, it means that we can have less dynamos, less engines, less boilers and less apparatus in general, than can be done with a system which requires 1,000 or 1,200 horse-power to operate the same number of cars. The cost of investment is less, and, of course, the interest is less. That is one advantage, and in addition the coal bill is much less. Another division would be the depreciation. We believe that the depreciation per passenger carried with our system can be made out less than with any other. We do not claim that it has been less in the past, although not greater. We have the best roads in the country; perhaps we have some of the poorest. It is a question of management and lies directly with you, gentlemen, as to the success of electric traction. In most cases, the motors do not receive the attention that would be given to an ordinary steam engine; and if you run them successively for 150 miles a day, and do not lay them up and treat them with care you cannot expect that your armatures will not burn out and other troubles ensue.

In the new apparatus that we are bringing out, we have made some very notable advances. In the first place, our armatures are wound upon an entirely new plan—one which we think is a distinct advance. In the old style, what is known as the Siemens' winding is employed; the wires are wound on the core and carried around at the end and form a conical shaped bundle, which gives a chance for play and abrasion; and this means short circuits and burn-outs. With the new armatures we have a new standard coil, some 60 of which go onto the core. They are so formed that the rear of the armature, and front alike, give no chance for motion. They are brought firmly in place, and you have a diameter of armature which is always the same, because the coils are standard. With this system burn-outs will be extremely rare. We do not claim that there will not be any; but we believe in the regular daily workings of the car, with proper management, nothing ordinary will burn out the machine except dead overloading. When it is burned out it can be replaced by any mechanic. The switches are on a little different plan. We have avoided the difficulty which has sometimes occurred of starting the car too suddenly, but which with careful management could always be prevented. We make it impossible to start suddenly by putting in a slow starting device, which starts the car gradually and effects a saving of power. It is not a rheostat. We are the only company that uses commutated field coils. We believe in them; we do not believe in the rheostat. You all know about our dynamos. The reason of their success is that they are a development and not an invention. Its efficiency is over 90 per cent. in the ordinary sizes, such as employed on street railroads; in some cases it is higher. One reason for its success is that its moving parts and center of gravity is near the floor. The line construction of the company is acknowledged to be standard, in respect to simplicity, neatness and cost. We use the feeder system. That is a system of wiring in which the electricity is delivered at regular intervals of a few hundred feet into a trolley wire. This results in the fact that the electricity is delivered to a large mesh work of conductors in such a way that at every point in these conductors the pressure will be uniform.

Mr. E. H. Johnson, of the Interior Conduit Company: I do not propose to occupy your time, but only desire to call your attention to the fact that the gradual development of the overhead electric system has become such that in many of the larger cities it is now becoming imperative that the conductor should be placed underground. In a city where 50 to 100 cars are operated, there is at least 95 per cent. of the wire on poles overhead which may, with advantage to the company, be placed under ground. It is not necessary to have them overhead. The trolley wire being the only thing that is necessary to have overhead, it follows that all the feeder wires, special mains, etc., may be placed underground. The question is, can the wires be placed underground with less investment, and can the insulation of the wires be maintained underground with less charge for repairs, and if so, how? Our company is prepared to lay down the wires underground and guarantee their efficiency for a number of years. Until it is rendered commercially successful, I propose to put the feeder wires underground, leaving the trolley wire to remain over head. The tubes are paper, treated with special asphaltic compound to render them insulated, and placed in a trench, and then filled with the insulating compound.

Mr. George W. Mansfield, representing the Thomson-Houston Company: As all the other companies have been represented, I suppose the Thomson-Houston Company ought to be also. I do not know that I can say anything in particular about our system, since it is the most generally used, and must be most generally known. We first started in the business with the feeling that the thing we had to do above everything else was to make as big a difference between the net receipts and the gross receipts of the company that purchased our apparatus as possible. We recognized the exigencies of the moment, and knew that we had to put our apparatus in the hands of men who were untechnical and were unskilled, and who knew nothing whatever about mechanics and electricity. We felt, therefore, that we had to build additionally strong to meet that necessity. We have put out in the neighborhood of 3,500 motors. I think they are nearly all running. The first motors we put out are in operation to-day, and gears, armatures, spools and the various parts constituting the motor, that are built to-day can be used with the motors first put out. We feel that we have planned on the correct principle. I want to make an appeal to you, gentlemen, much in the same vein as my predecessor, Mr. Higgins. That is, regarding the management of the electric apparatus. If there is any one thing that has injured the business in the eyes of the public, who are not interested in electric roads, it is in many instances lack of management on the part of the railway companies that are operating the electrical apparatus. Many roads are a disgrace to the directors and every one connected with the company, because the motors are kept in dirty condition. They are not handled by men who have the requisite skill and intelligence. Any one knows if a steam engine is not taken care of it goes to pieces; and the same is quite as true of electric motors. The railroads should employ men of skill, and brains, and intelligence, to look after these mechanical and these electrical details; and the more information, the more knowledge they have, the better they will perform their work.

In regard to new apparatus, we are constantly improving all our details. We are making the motor stronger wherever experience has dictated it to be necessary, and we are making it lighter wherever it is necessary. We are improving each detail of the entire apparatus, and increasing efficiencies; so that in a very short time we will have the most complete system. Our switches at each end of the car are under the hood of the car, so that in case of any accident or any trouble, the conductor at the rear end can cut the circuit, either with his switch or by pulling a trolley wire down; and the driver also has that facility. We have a fuse box on our car, and it is a very simple matter to replace a fuse if the driver has been careless, or ignorant or unskilled, and turns his current too quickly on. That operates as a check against the man as well, as a record can be kept of the number of fuses used. We have a lightning arrester which we claim is the only one of practical value. As to our motors, we build 10, 15 and 20 horse-power of one type, and the same power of another type, so that we can use our motors either singly or double upon trucks of any gauge, from three feet three inches up to six feet. If the railroad men would get down to a uniform gauge, it would help us out very much. As to station apparatus, our dynamo has an efficiency of over 90 per cent. It will pull through more hard raps and do more service in a given space of time than any other. In our new work we are pushing ahead and building dynamos up to 2,400 and 2,500 horse-power, and directly coupled to engines also. We are building heavy motors for excessive work and for tow work; and we are going into all sorts of devices and experiments in regard to constant speed motors and slow speed motors. We want to be sure first that any new thing is far superior to what we have, before we put them before the public.

Mr. Richardson: What is your expectation as to having something better in the near future?

Mr. Mansfield: I do not know exactly how to answer your question; but I do not think the electrical appliances will improve more than 15 or 20 per cent. for many years to come.

Mr. Richardson: You cannot promise anything in the next six months?

Mr. Mansfield: No, sir.

In addition to the subject of electricity, the Association considered the following subjects, special reports having been presented thereon: "A Perfect Street Railway Horse," "Novel Schemes for the Development of Street Railways," "Public and State Treatment of Corporations," "Spiral or Transition Curves for Street Railroads Operated by Mechanical Motors."

The Association had its annual banquet on Thursday evening, and on Friday the delegates, accompanied by their wives and daughters and all the gentlemen interested in the Association, including non-delegates, were taken by special train to Niagara Falls by courtesy of the Buffalo street railroad companies.

Before the Association adjourned, the following officers were elected: Henry M. Watson, Buffalo, N. Y., president; W. A. Smith, Omaha, Neb., vice-president; Charles Odell, Newburyport, Mass., second vice-president; A. D. Rodgers, Columbus, O., third vice-president; William J. Richardson, Brooklyn, N. Y., secretary and treasurer. The executive committee is as follows: Thomas Lowry, Minneapolis, Minn.; D. F. Henry, Pittsburgh, Pa.; Albert E. Thornton, Atlanta, Ga.; H. M. Littell, Cincinnati, O.; Thomas C. Keefer, Ottawa, Canada.

The next meeting of the Association will be held in Pittsburgh, Pa., the third Wednesday in October, 1891.

THE EXHIBITORS.

The Arcade Hall, which was set aside for the exhibitors, was, at the time of selection, thought to be large enough, yet room was at a premium the day before the Convention opened. The exhibits were all of an interesting nature, and the hall was crowded during the day and evening by delegates and visitors.

Pratt & Letchworth, of Buffalo, occupied a large space at the left of the entrance. The company made an interesting display of harness, car trimmings, etc. They were ably represented by Messrs. Crosby, Sears, Strong, Chisholm and Edson.

Hathaway & Robinson, of Cleveland, Ohio, exhibited one of their famous transfer tables. A. G. Hathaway represented his firm.

The Volk Cable Crossing, Grip and Car Brake Co. had a small car equipped with their patent grip on exhibition. Dr. K. Morgner explained the working of same.

The J. G. Brill Company exhibited a section of one of their improved vestibuled cars. This was in the rough, showing the manner of building, the material used and the ironing, which demonstrated the strength of the car. The company had, also, pleasant reception parlors in the Iroquois Hotel.

The Blondell Manufacturing Co., of Baltimore, Md., was represented by J. M. Blondell. This company exhibited their patented truck and gear.

Emmet Bros., of New York, displayed a a full and neat line of electric railway supplies. They were represented by W. L. R. Emmet.

Combination car stoves with coal box was exhibited by the James Spear Stove & Heating Co.

The Fulton Foundry Co., of Cleveland, Ohio, made a large display of cogs, pinions, gearing, etc. The company was represented by Messrs. T. C. White and C. J. Langdon.

The Berlin Iron Bridge Co., of East Berlin, Conn., had a long table in the lower end of the hall on which were displayed photographs of different styles of bridges built by this company.

Delegates and visitors who registered at the Michigan Stove Co.'s exhibit were presented with a neat paper weight in the shape of a frog. This company displayed different styles of car heaters, and were represented by F. P. McCanna, of Buffalo.

The Okonite Co. had an exhibit space in which were shown their celebrated wires, cables, etc. The home office was represented by T. McCoubray. Mr. S. Ames, the Buffalo agent, was also present.

Chas. A. Schieren & Co., manufacturers of perforated and link belting, had a convenient space, and were represented by G. H. Fisher and Mr. Atkinson.

The Hale & Kilburn Manufacturing Co., of Philadelphia, Pa., exhibited car seats and springs. Mr. E. L. Hendrick represented this company.

The Hercules Car Brake and Starter Co. were represented by the secretary and general manager, H. W. Littlefield.

Gould & Watson, of Boston, Mass., manufacturers of moulded mica insulators, were represented by R. B. Pierpont.

The North American Construction Co., Buffalo agents for the Westinghouse, made a splendid display of cut-out branch blocks, electroliers, motors, arc and incandescent lamps. Incandescent lamps in full glow, from 16 to 150 candle-power, were neatly arranged on the large display board. The company was represented by W. L. Adams.

The Edison General Electric Co. covered the largest space in the hall, and exhibited everything pertaining to electric railways and power plants. Their improved railway motor, mounted on Gilbert trucks, was a feature of interest. Underground conduits and junction boxes were also displayed.

The Connecticut Motor Co. made a neat display of motors, the largest of which was decorated with a sign "Sold." Mr. F. C. Rusling ably represented the company.

The American Electric Supply Co., of Buffalo, manufacturers and dealers in electric light, railway and power supplies, filled a good sized space with novelties in the above lines. The company was represented by Chas. M. Proctor.

C. S. Van Nuis made a fine show of his celebrated Ajax switches.

The Stanwood Manufacturing Co., of Chicago, represented by F. H. Stanwood, made an interesting display. This company has recently placed on the market a novelty in the way of an insulated car step.

F. S. Pease, of Buffalo, had a small space in the hall in which was shown upwards of 150 prize medals for high grade lubricating oils.

The Bickford & Francis Belting Co., of Buffalo, were among the exhibitors, and were represented by H. N. Gardner.

The Wenstrom Dynamo Co. were the first exhibitors at the left of the main entrance. Here was shown a large generator of the Wenstrom make. The company was represented by Messrs. A. H. Chadbourne and Wm. Hazelton. These enterprising gentlemen also had large and pleasant headquarters in the Hotel Iroquois, and their motor attracted great attention.

The following companies occupied spaces n the hall and were well represented:

Collett Car Brake Co., Boston.

R. Hoffeld Co., Belting, Buffalo.

New York Car Wheel Co., Buffalo.

Eureka Tempered Copper Co., North East, Pa.

Frost Veneer Seating Co., New York, Lemuel Wm. Serrell, agent.

Milliken poles for electric railways.

A. Whitney & Sons Car Wheel Works, Phila., Pa.

Burlington Woolen Co., conductors' suits, etc.

Pierce Bros., Trolley Wire Holder, Boston, Mass.

Gibbon Duplex Railway Track Co., New York; a new thing that promises well.

Rowell American Switch Co., Boston, Mass.

The Aenchbacher Railway Track Co., New Orleans, La.

Morton Safety Heating Co., of Baltimore, Md.

The Standard Underground Cable Co. exhibited samples of their well-known wire and cables at the Tifft House. Mr. Geo. L. Wiley, of the New York office, represented the company.

One of the most interesting exhibits at the Convention was that of the Short Electric Railway Co., whose large reception room was on the office floor of the hotel. There the delegates were shown the Short motor in operation. The motor was mounted on a table in the center of the room, the current being supplied by wire from the hotel dynamo. Photographs of the different forms of motors, generators, trucks, adorned the walls. On a very neat display board were shown the different appliances for use in connection with their system. The above company's private car, which stood on Eagle street near the main entrance, attracted much attention, the car was built by the Gilbert Car Manufacturing Co. and was very handsome. The truck was a "Brill" on which was mounted the Short motor. The gentlemen present who represented the company, were as follows: President Sidney H. Short, H. R. Kinzelbach, John E. Ridall, general manager, and S. B. Fortenbaugh; vice-president Potter came over from Cleveland Thursday.

The Electric Merchandise Co., of Chicago, occupied Parlor F, and made a very interesting display of switches, pinions, brushes, trolleys, headlights, and in fact everything pertaining to electric railway supplies. The rooms of the company were crowded most of the time, which is good evidence of the popularity of the company. Representing this company was their ever genial general manager, Mr. W. R. Mason, who was assisted by Mr. John Gustin.

The Edison General Electric Co. occupied the large Parlors G and H. The brilliant sign displayed in the corridor, composed of four candle-power incandescent lamps (eight in series) reading, "Edison General Electric Company," was a beautiful and appropriate one. In one corner of Parlor G a phonograph amused the visitors. The company was represented by the following gentlemen: John Muir, E. E. Higgins, C. D. Shain, F. R. Chrinnock, Chas. Hughs, J. H. Vail, J. G. White.

Chadbourne, Hazelton & Co., who occupied the ladies' parlor, were kept busy entertaining their many visitors with descriptions of the Wenstrom motor. This company's display consisted of motors, gearings, generators, etc. A beautiful new catalogue was freely distributed. Messrs. Chadbourne and Hazelton quite royally entertained all.

The J. G. Brill Co., were on hand and occupied Parlor E. Miniature trucks were exhibited, and the guests entertained by J. A. Brill and Payson K. Andrews. The catalogues given away to the visitors were of the highest order, and were complete in every detail.

The Westinghouse Co. held forth in Room 56, and were represented by the following gentlemen: H. McL. Harding, F. A. Scheffler, J. L. Atkinson, J. L. Barclay,

J. M. Dennison, G. K. Rose and J. A. Rutherton. Mr. Fred. Pullman had charge of the handsome Pullman car at Cold Springs, on which was the new Westinghouse motor.

The Thomson-Houston Co. were elegantly situated on the third floor, having secured the private apartments of Mr. Woolly, the proprietor of the Iroquois. A reception was given by the above company on Tuesday evening, and was largely attended, everybody enjoying a delightful evening. This company gave an exhibition of their sweeper and snow plow on the Cold Spring division of the Buffalo Street Railway. These unique devices were never before exhibited at any convention, and were greeted with praises from every quarter. The company was ably represented by the following: Messrs. W. Coffin, Mansfield, Stebbins, Barr, Galvin, Cargill, Clark, McCarty, Morse, Cahoun and Wiggins.

The Interior Conduit Co. occupied space at the end of the corridor on the parlor floor, where were exhibited conduits, interior and underground, manholes, junction boxes, etc. President E. H. Johnson, of the company, was present, as was also E. W. Little, the general manager, and Clift Wise, the chief engineer.

The Detroit Electrical Works exhibited a model of the Rae motor, and much attention was given it by all. The peculiar construction of this motor was a prominent feature of the exhibit, and many praises were heard for its form and workmanship. In all roads equipped by this new motor the best of satisfaction is reported. The representatives present were C. A. Benton and Paul W. Bossart.

PERSONAL.

Among the well-known gentlemen whose presence gave the gathering quite an electrical coloring, were H. L. Shippey, E. H. Johnson, C. D. Shain, T. McCoubray, C. R. Field, Frank G. Stone, A. H. Chadbourne, N. McCarty, D. H. Bates, H. McL. Harding, J. L. Barclay, Paul Bossart, M. E. Baird, C. A. Benton, Dr. A. F. Mason, Theo. Larbig, G. W. Mansfield, C. C. Curtis, C. J. Field, J. R. Davis, C. R. Huntley, B. Rhodes, the representatives of the electrical press, F. A. V. Perrine, Wm. Hazelton, J. W. Godfrey, C. E. Newton, Elmer A. Sperry, G. L. Wiley, G. C. Bailey.

Mr. E. L. Tunis, of Baltimore, president of the Wenstrom Motor Company, arrived on Thursday, accompanied by ex-Governor Broome, director in the same company, and was greatly pleased to find the interest that centered around the Wenstrom motor.

Copies of the REVIEW were much sought after by the street railway men, who expressed much interest in the new work of Mr. Eickemeyer, as described in last week's issue.

Mr. G. C. Collingwood, representing the Indurated Fibre Company, of New York, made many friends among the electrical and railway people. The fact that the pipe of this company is being used by the Buffalo Street Railway Company for its underground feeder system, caused its merits to be freely discussed by the railway men.

Mr. H. F. Probert represented the Sheffield Velocipede Car Company, the manufacturers of the Three Rivers Electric Motor truck. A beautiful model of this excellent truck was shown with a model of the Rae motor, and both it and the motor attracted great attention. As a piece of mechanical neatness and skill, this motor and truck made one of the handsomest exhibits to be seen at the Convention.

Mr. J. H. McGraw, editor of the *Street Railway Journal*, New York, was one of the busiest men at the Convention, publishing a well printed and complete daily at 7 o'clock each morning. Copies were eagerly sought for in all directions. The ELECTRICAL REVIEW and the *Street Railway Journal* had their headquarters in convenient parlors on the parlor floor, and these were made the visiting headquarters of the electrical and railway men generally.

Messrs. D. H. Bates, W.W. Griscom, W. B. Van Sise and E. A. Scott, were in attendance on the Convention, representing the Accumulator Company, of New York, and the Edco motor of Philadelphia.

Mr. John D. Elwell, of New York, representing the Gibbon Duplex Track Company, made friends of every one he met.

The Hotel Iroquois was crowded to overflowing, but everybody received good treatment.

General Notes.

The Buffalo Street Railway Company issued a complimentary set of tickets, good over all the street car lines of the city, to each Convention attendant.

The street railway men admit that the Convention was the liveliest one ever held, and the electric men made it so.

This Association is eight years old, the first Convention being held in Boston, December 12-13, 1882.

Mr. Thomas Lowry made a pleasant and dignified presiding officer.

Mr. John Pugh and John A. Tackaberry represented the well known car builders, The John Stephenson Company, of New York.

John A. Roebling's Sons Company, of Trenton, N. J., exhibited a case containing samples of various types of bare and armored and insulated wires.

The Eureka Tempered Copper Company, of North East, Pa., had a fine exhibit of their goods, and were represented by A. L. Daniels.

The Aluminum Brass & Bronze Company, of Bridgeport, Conn., were represented by F. G. Stone, and had a very unique exhibit of the uses to which aluminum may be put in a trolley head and wheel made of it, which, compared with brass, weighs almost nothing.

The Lewis & Fowler Manufacturing Company, of Brooklyn, had a fine exhibit on the first floor of the hotel. This company chartered a number of special Pullman cars and took their friends to Buffalo and return on the picturesque Erie. Their guests were treated very handsomely.

Theo. Larbig said kind words for Holmes, Booth & Haydens, and F. A. Magee did the same for The E. S. Greeley & Co.

Mr. Chas. R. Huntley, the well-known electric light general manager of Buffalo, was untiring in his efforts to make the electrical visitors appreciate Buffalo.

W. H. Gordon, of New York, was present making the acquaintance of hosts of electric railway people.

Messrs. Hall, Palmer and Culvertson, of the Bell Telephone Company, welcomed many old friends among the electrical visitors.

The Wainwright Company, of Boston, distributed a number of tasty memorandums that everybody took pains to secure and preserve.

The smooth running Pullman car, with Westinghouse electric motor, was kept busy all day Thursday carrying visitors over the full length of the line at Cold Springs. The car was very handsomely fitted up, and the electrical machinery was in perfect harmony with it.

Electricity in a Silver Mine.

Since the operation of electric machinery of the Westinghouse manufacture has been so successful in several Pennsylvania coal mines, the demand for that company's apparatus is rapidly increasing and has extended to the large mining districts of Colorado. The result of this has been that the Westinghouse Company is now engaged in manufacturing power apparatus for the operation of a silver mine owned by the Gold King Mining Company, of Telluride, Col. The mine in question is situated on the top of a mountain about 2,000 feet high, and as the cost of coal is a great factor in the operation of a mine under such circumstances, the advantages of electric power over steam can be easily appreciated. At the foot of this mountain is a very strong waterfall, and this power the mining company intends to utilize in conjunction with the electrical apparatus. It has been decided to place the electric plant containing apparatus to generate 100 horse-power near this waterfall and by this means the power is to be transmitted to the motors at the summit of the mountains, where the mining operations are being conducted.

FINANCIAL.

Closing quotations of electric stocks, from F. Z. Maguire, Electrical Securities, 18 Wall street, N. Y., Saturday, October 18, 1890. New York, Boston and Washington Stock Exchanges.

NEW YORK.	
Western Union Telegraph Co.	81⅞.
Edison General Electric Co.	96.
" " " Deferred	86.
Consolidated Electric Light	
Edison Electric Illuminating Co.	*70.
United States Electric Light	80.
BOSTON.	
Thomson-Houston Electric Co.	51¾.
" " " Preferred	26⅝
" " " Series C	11¼
" " " Series D	6⅛.
" " International	
" Welding Co.	180.
" European Welding Co.	71.
Ft. Wayne Electric Co	12.
TELEPHONE:	
American Bell	292.
Erie	50½
New England	39¾
Mexican	.85
Tropical American	
MISCELLANEOUS:	
Edison Phonograph Doll	2.
WASHINGTON.	
Pennsylvania Telephone	25.
Chesapeake and Potomac	*68.
American Graphophone	15.
United States Electric Light (Washington)	150.
Eckington and Soldiers' Home Railway	85⅛.

*Ex. Dividend.

F. Z. MAGUIRE,
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CHICAGO, 46 SOUTH CANAL STREET.

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Manufacturers and constructors of glazed Terra Cotta conduits for electric wires of all descriptions. Approved by the engineers of the District of Columbia and local companies. Can be examined by interested parties.

INVENTORS

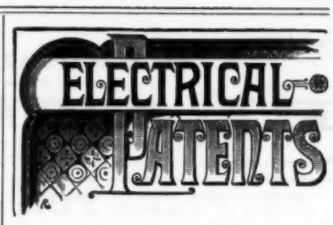
Coming to Washington to further any electrical patents, will profit by calling on **C. W. Messner, of 1225 F St., N. W.** All the appliances necessary for tests, experiments, etc. Also, Electrical Contractor and Constructor. Special attention to isolated plants. Agent for the "C. & C." electric motor—sizes, ⅛ to 50 horse-power. The only electric motor on the market to-day.

YOU make a mistake if you don't buy your Electrical Supplies from F. & F., Cleveland, O.

LOOK AT THESE PRICES:

$2 Electric Bells, 50c., 75c. Bronze.
Push Buttons, 25c.; 25c. Wood Push.
Buttons, 7c.; 50c. Switches, 15c.
40c. Bell Hangers' Staples, per lb., 10c.
$1 Leclanche Batteries, 45c.
$1 Carbon Batteries, 40c.
$3.75 Spark Coils, $1.50; $10 Medical Batteries, $3.50.
Dry Batteries, Motors, Dynamos and Annunciators at half price. Send for reduced price list and discounts.

Fletcher & Fletcher Electric Co., Cleveland, O.



INDEX OF INVENTIONS FOR WHICH LETTERS PATENTS OF THE UNITED STATES WERE ISSUED ON OCTOBER 15, 1890.

438,134 Electric arc lamp; Alfred Apps, London, England.

438,145 Regulation and control of storage batteries. 438,226 Apparatus for measuring the strength of electric currents. 438,532 Insulating appliance for electric batteries; Stanley C. C. Currie, Philadelphia, Pa., assignor to the United Gas Improvement Co., same place.

438,167 Circuit closer; Thos. Marcher, Newmarket, near Nuremberg, assignor of one-half to Ferdinand Emecke, Berlin, Germany.

438,192 Electric motor car; Jabez F. Shawhan, Detroit, Mich., assignor by direct and mesne assignments to the Shawhan Motor Co., of Michigan.

438,197 Gearing for motor cars; Oliver C. Smith, Ipswich, Mass., assignor to the Electric Rapid Transit Co., of New Hampshire.

438,204 Electric motor; Elihu Thomson, Lynn, Mass., assignor to the Thomson-Houston Electric Co., of Connecticut.

438,211 Support or hanger for trolley wires; Herbert C. Wirt, Boston, Mass.

438,219 Trolley pole; Johan M. Anderson, Boston, Mass.

438,233 Telegraph instrument. 438,234 Circuit closer; John Geary, Philadelphia, Pa.

438,236 Electric safe lock; William H. Hollar, Elizabeth, N. J., and Frederick S. Holmes, Malden, Mass., assignors to James N. Torrey, Merchantville, N. J.

438,260 Electric switch; Chas. W. Smith and Cornelius J. Lyons, Boston, Mass.

438,262 Electrical railway conduit system; Malone Wheless, Nashville, Tenn.

438,263 Electric railway system; Frank J. Sprague, New York, N. Y.

438,298 Manufacture of incandescent electric lamps. 438,299 Manufacture of carbon filaments; Thos. A. Edison, Menlo Park, N. J., assignor to the Edison Electric Light Co., New York, N. Y.

438,300 Gauge for testing fibres for incandescent lamp carbons. 438,301 System of electric lighting. 438,302 Commutator for dynamo-electric machines. 438,303 Arc lamp. 438,304 Electric signaling apparatus. 438,305 Fuse block; Thos. A. Edison, Menlo Park, N. J.

438,306 Telephone; Thos. A. Edison, Menlo Park, N. J., and Ezra T. Gilliland, New York, N. Y.

438,307 Manufacture of incandescent electric lamps. 438,308 System of electrical distribution. 438,309 Method of insulating electrical conductors. Thos. A. Edison, Llewellyn Park, N. J.

438,310 Lamp base; Thos. A. Edison, Orange, N. J.

438,311 Composition of matter for making cells or retaining vessels. 438,312 Acid-proof retaining vessel. 438,313 Composition for cells or retaining vessels; Oscar A. Enholm, New York, N. Y., assignor, by direct and mesne assignments, to the Enholm Electrical Construction Co., same place.

438,326 Automatic cut-out; George N. Richardson, Philadelphia, Pa., assignor of one-half to Edw. D. Gross, same place.

438,344 Circuit interrupter; Nicholas Chaize and Jacques Chaize, St. Etienne, France.

438,357 Method of and apparatus for magnetic separation of ores; John M. McMahan, New York, N. Y., assignor to John D. Cheever, same place.

438,359 Trolley wheel for electrically propelled vehicles; Louis Pfingst, Boston, Mass.

438,390 Annunciator; Arthur F. Stanley, New York, N. Y.

438,394 Thermal cut-out; William R. White, Hartford, Conn.

438,400 Connector for electric conductors; Geo. J. Brennen, Lynn, assignor, by direct and mesne assignments, to Edw. Frost, Littleton, and Arthur W. Tufts, Boston, Mass.

438,404 Contract for overhead electric railways; Albert A. Chadbourne, Philadelphia, Pa.

438,406 Method of utilizing electricity in the formation of sheet metal articles. 438,407 438,408 Apparatus for forming or shaping sheet metal electrically. 438,409 Method of utilizing electricity in the formation of metallic cartridge cases; Mark W. Dewey, Syracuse, N. Y., assignor to the Dewey Corporation, same place.

438,419 Electric light shield; Alfred A. McCreary, New York, N. Y.

438,431 Incandescent electric lamp socket; Jas. W. Collier, New York, N. Y.

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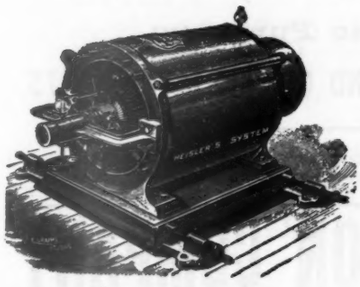

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C	8	.....	.....	.....	6.5	1¼	5,000 FEET PER MINUTE.	530
CC	.....	10	.....	.....	6.3	1½		530
CCC	.....	.....	.....	25	8.0	2		530
E	16	.....	.....	.....	12.0	2½		780
EE	.....	20	.....	.....	12.5	2½		780
EEE	.....	.....	26	.....	13.0	2½		780
F	20	.....	.....	.....	15.0	3		990
FF	.....	25	.....	.....	15.6	3		990
FFF	.....	.....	32	.....	15.0	3		990
G	.....	.....	.....	50	16.0	3		990
G	28	.....	.....	.....	21.0	4½		1,360

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G	.....	35	.....	.....	21.0	4	5,000 FEET PER MINUTE.	1,360
GG	.....	.....	45	.....	21.0	4		1,360
GGG	.....	.....	.....	70	21.0	4½		1,360
H	40	.....	.....	.....	29.7	6		1,750
HH	.....	50	.....	.....	30.0	6		1,750
HHH	.....	.....	64	.....	29.5	6		1,750
I	52	.....	.....	.....	38.0	8		2,290
II	.....	65	.....	.....	38.6	8		2,250
III	.....	.....	83	.....	38.0	8		2,290
J	64	.....	.....	.....	46.5	10		2,770
JJ	.....	80	.....	.....	47.1	10		2,770
K	75	.....	.....	.....	52.5	12		3,300

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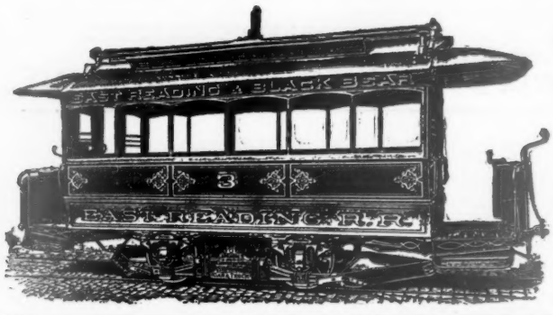

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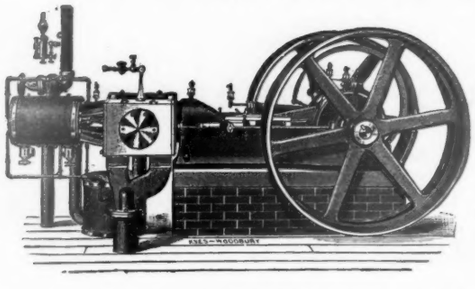

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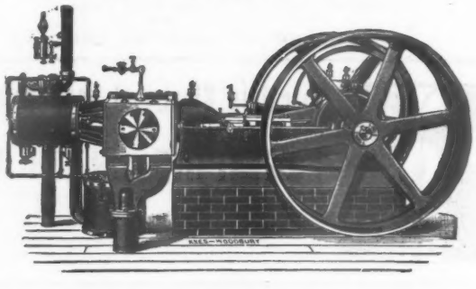

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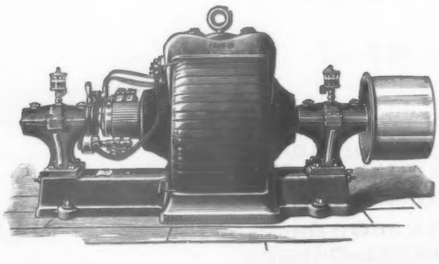

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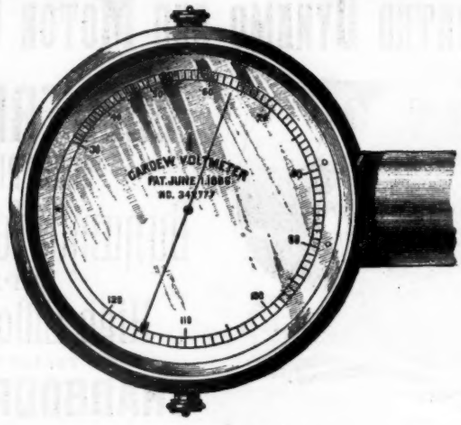

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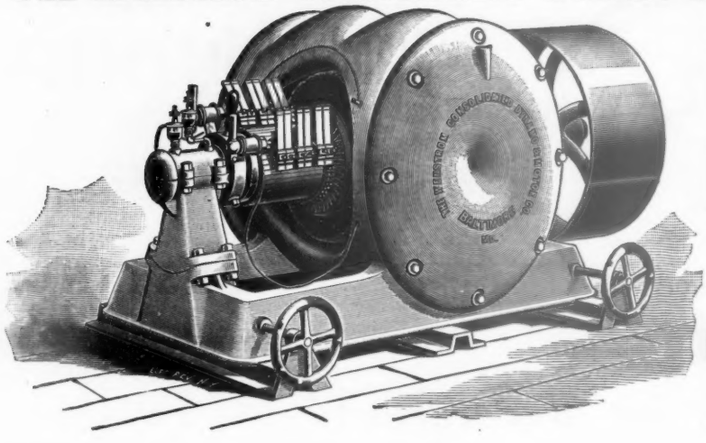

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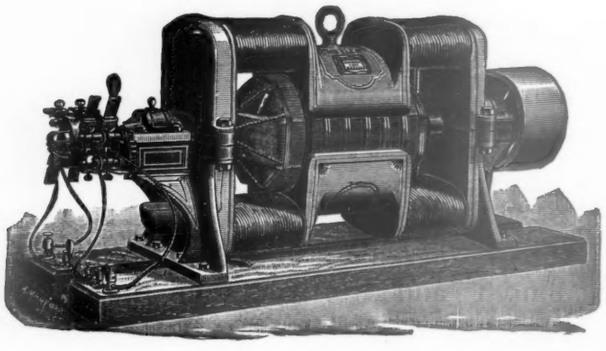

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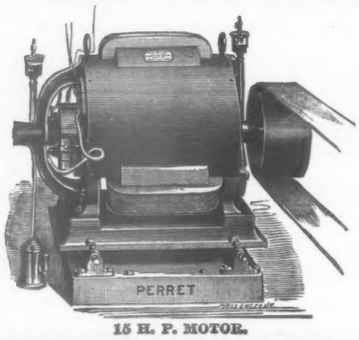

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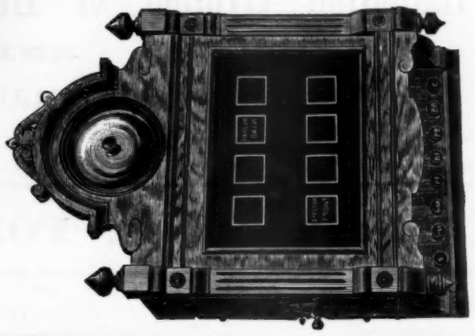

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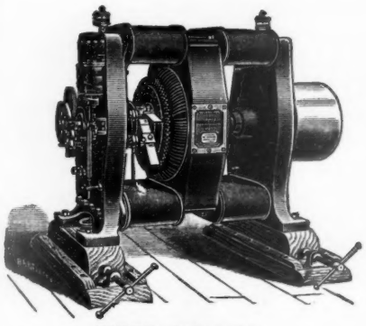

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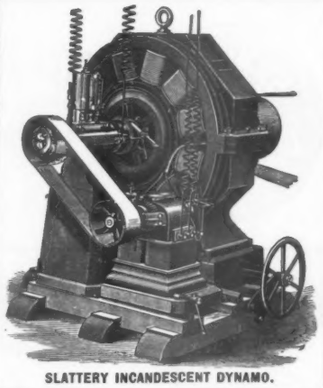

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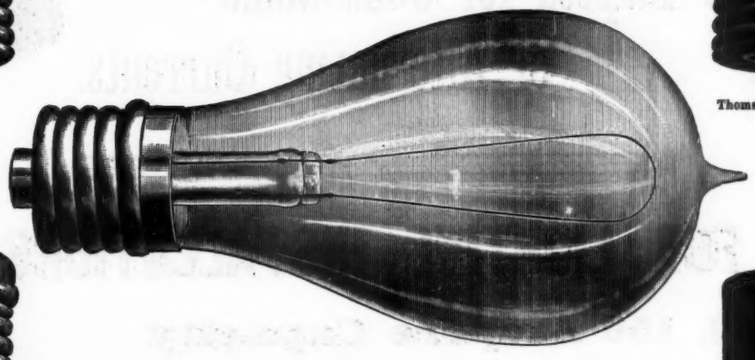

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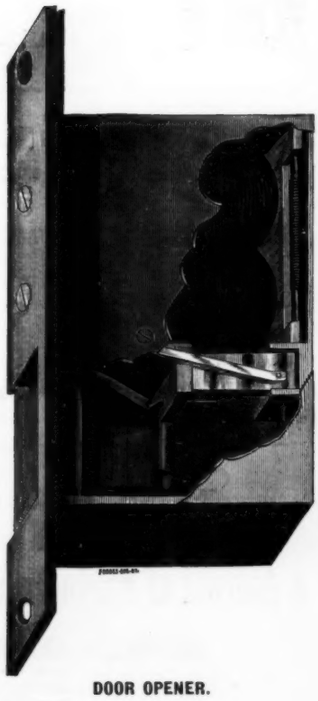
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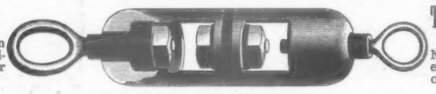

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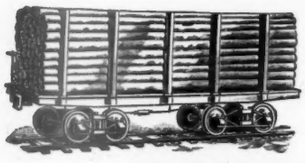

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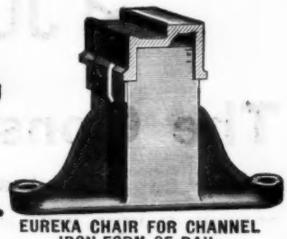

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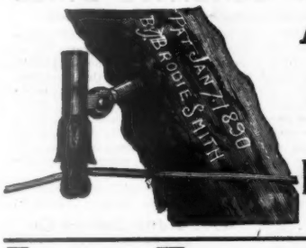

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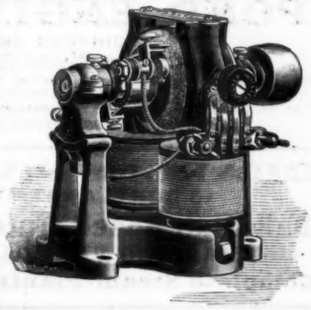

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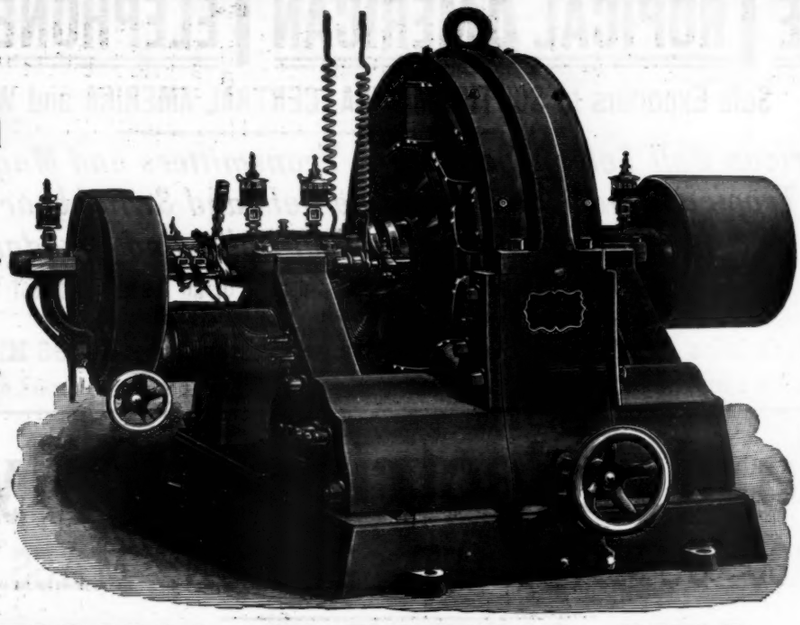

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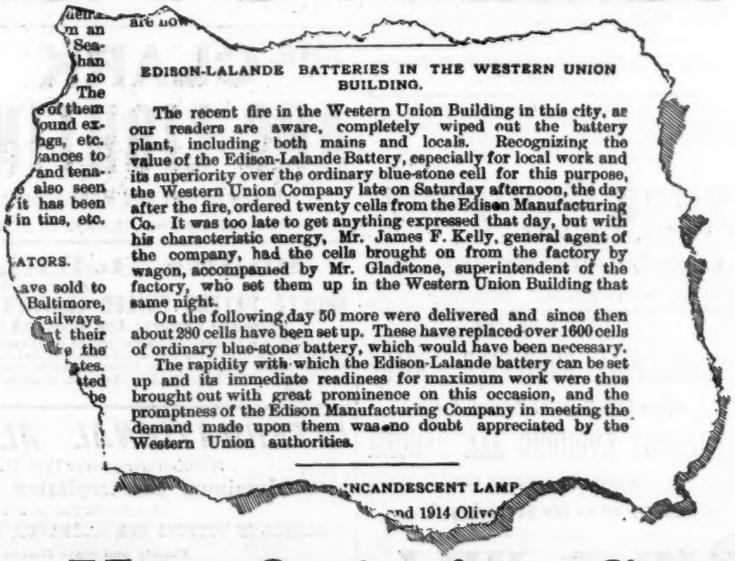

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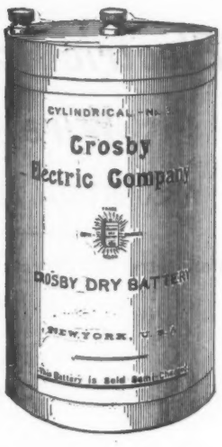

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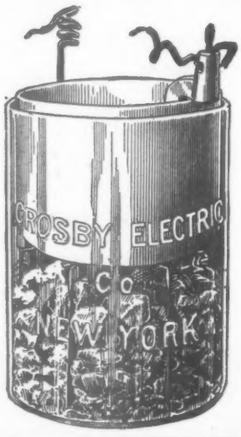

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